PAGE'S WEEKLY.—November 3, 1905. Thin Paper Copy for Circulation Abroad.

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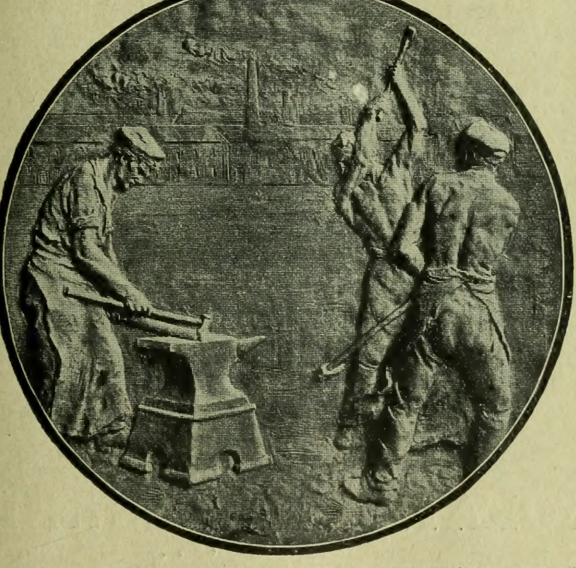
PAGE'S WEEKLY



ENGINEERING · ELECTRICITY SHIPBUILDING · MINING IRON & STEEL INDUSTRIES

EDITORIAL & PUBLISHING OFFICES, CLUN HOUSE, SURREY STREET, STRAND, LONDON, W.C.

FRANCE, Paris : 22, Rue de la Banque.
GERMANY, Berlin : 13, Unter den Linden.
RUSSIA, St. Petersburg : 14, Nevsky Prospect.
ITALY, Rome : 307 Corso.
AUSTRIA, Vienna : Kärntnerstrasse, nr. 30.

INDIA, Calcutta : Thacker, Spink & Co.
" Bombay : Thacker & Co., Ltd.
SOUTH AFRICA, Cape Town : Gordon & Gotch.
JAPAN. Yokohama : Kelly & Walsh, Ltd.
NEW ZEALAND : Gordon & Gotch, Ltd.

CANADA : Montreal News Company.
UNITED STATES, New York : International News Co.
" Chicago : Subscription News Co.
AUSTRALIA, Melbourne : Gordon & Gotch.
STRAITS SETTLEMENTS, Singapore : Kelly & Walsh, Ltd.

PAGE'S WEEKLY — Miscellaneous

Mr. G. H. HUGHES, M.I.Mech.E.,

Consulting and Organising Engineer for Water Works and Industrial Undertakings,

19, OLD QUEEN ST., WESTMINSTER, S.W.

Telephone No.: 5754 Bank. Write for particulars.

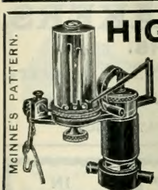
PAGE & ROWLINGSON,

Chartered Patent Agents.

Handbook of Information Free.

28, NEW BRIDGE STREET, LONDON, E.C.,

And 14, St. Ann's Square, Manchester.



HIGH SPEED INDICATORS.

Hannan & Buchanan,

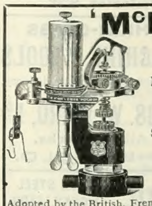
75, Robertson Street, Glasgow.

ENGINE COUNTERS.

BOURDON GAUGES.

On Admiralty List.

Engineering Instrument Makers



'McINNES-DOBBIE' INDICATORS.

In Two types: External and Enclosed Pressure Springs.

Each made in several forms and sizes to suit all speeds and pressures.

Special Indicators for Gas, Winding, and Ammonia Engines, and for Motor-Cars.

DOBBIE, McINNES, LIMITED,

45, BOTHWELL ST., GLASGOW.

Adopted by the British, French, and Japanese Admiralties.

A. MOUNT-HAES,

M.I.Mech.E., M.I.M.E.,

Consulting and Mining Engineer for Ore Dressing Plants of All Classes.

II, IRONMONGER LANE, LONDON. E.C.

Tel. Address: "DRESSINGS, LONDON." Telephone No.: 272 Central.

BABCOCK & WILCOX, Ltd.

PATENT WATER-TUBE BOILERS.

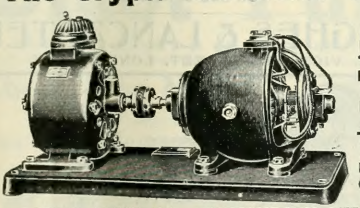
These Boilers are in use throughout the world to the extent of 4,700,000 h.p. generating steam for all purposes, and fired with all kinds of fuel.

See our Advertisement appearing Nov. 24th, page 37.

HEAD OFFICES—Oriel House, Farringdon Street, LONDON, E.C.

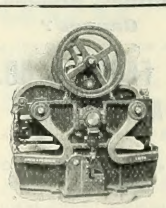
WORKS—Renfrew, SCOTLAND.

The Crypto Electrical Co.,



ALTERNATING TRANSFORMERS

3, TYERS GATEWAY, BERMONDSEY STREET, LONDON, S.E.



PUNCHING & SHEARING Machines.

STEAM HAMMERS.

Shipbuilders' MACHINE TOOLS.

DAVIS & PRIMROSE,

Leith Ironworks, EDINBURGH.

BRETT'S PATENT LIFTER CO., LTD.,

COVENTRY, ENG.

Speciality—

FORGING PLANT.

See our Advertisement appearing Nov. 24th.

SEND FOR LATEST CATALOGUE.

WAYGOOD LIFTS

APPLY FOR CATALOGUE.

FALMOUTH ROAD, LONDON, S.E.

Melville and Macalpine, Consulting Engineers and NAVAL ARCHITECTS,

615, WALNUT STREET, PHILADELPHIA, PA., U.S.A.

Rear-Admiral GEORGE W. MELVILLE, Ex-Engineer-in-Chief of the United States Navy, and JOHN H. MACALPINE, having a very extensive acquaintance in the best engineering circles in the United States, Britain, and the Continent of Europe, especially SOLICIT INTERNATIONAL BUSINESS

DESTRUCTORS and CLINKER MACHINERY.

Horsfall Destructor Co., Ltd., Armley, Leeds.

Telegrams: "DESTRUCTOR." Telephone: 2006.

Codes: A.B.C. (5th Edition) and Leiber's.

The only firm in the United Kingdom who

SPECIALISE in the PHOTOGRAPHING of MACHINERY.

BOOKER & SULLIVAN, 67 & 69, Chancery Lane, LONDON, W.C.

TERMS ON APPLICATION. Telephone: 9252 CENTRAL.

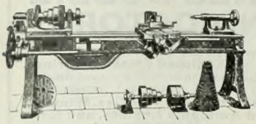
PAGE'S WEEKLY Miscellaneous

THE CASE IN A NUTSHELL.

You understand the Manufacture of the goods.
We understand the Effectual Advertising of them.
The combination of the two forces produces the desired result—increased sales.

We reiterate—our aim is not to increase your advertising expenditure, but to make that expenditure more productive. May we show you how?

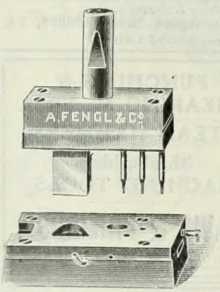
THE BRITISH ADVERTISER SERVICE BUREAU,
Queen Anne's Chambers, Westminster, S.W.



HIGH-CLASS
MACHINE TOOLS
In stock for immediate delivery.

THOS. W. WARD, L^D.
Albion Works,
SHEFFIELD.

WALTER SCOTT, LTD., LEEDS STEEL WORKS, LEEDS, ENGLAND.
MANUFACTURERS OF . . .
Rolled Steel Joists, Channels, etc.
Mild Steel Blooms, Billets, Slabs, Tinbars, Rounds and Flats.
Speciality: TRAMRAILS.



DO YOU WANT ANY
Press Tools, Jigs, Cutters, Rimers, Gauges?
If so, send your requirements, and
A. FENGL & CO., ALTRINCHAM,
will submit design and price.

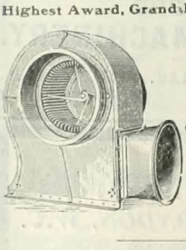
Inventors' Models Worked Out and Manufactured.

STAMPINGS TO THE TRADE.
Telegrams: "Fengl, Altrincham."

TRANSPORTERS.
See our Advertisement appearing Nov. 24th.

TEMPERLEY TRANSPORTER CO.,
72, Bishopsgate Street Within, LONDON, E.C.
Telephone: 365 London Wall. Telegrams: "Transumo."

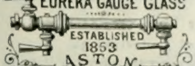
Highest Award, Grand Prize, St. Louis Exhibition, 1904.



"SIROCCO" FANS,
For Induced Draught on Boilers, Heating, Cooling, Ventilating, etc.
DAVIDSON & CO., LTD.,
"Sirocco" Engineering Works, Belfast
13, Victoria St., Westminster, LONDON, S.W.
37, Corporation St., MANCHESTER.
115, Hope St., GLASGOW.

Sole Continental Representatives: Messrs. WHITE, CHILD, & BENEY, Ltd., 62/63 Queen St., Cheapside, LONDON, E.C.

J. TOMEY & SON'S
EUREKA GAUGE GLASS



ASTON
BIRMINGHAM.

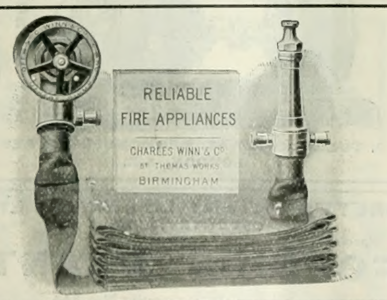
A NEW GAUGE GLASS.
Samples, Lists, and Testimonials on application

"S.H.P."
Tested to 350lb. Steam Pressure. **For High Pressure Boilers.**

STONE BREAKERS,
GRAVEL WASHERS, ETC.
SAMUEL PEGG & SONS, Engineers,
LEICESTER, England.
SEND FOR ILLUSTRATED CATALOGUE.

FORTUNES IN WASTE
FIRE WOOD AND LIGHTER MACHINERY
M. GLOVER & CO., Patentees, LEEDS.

SHONE PNEUMATIC EJECTORS
FOR RAISING SEWAGE, SLUDGE, WATER, &c.
Air Compressing Machinery
FOR ALL SERVICES.
HUGHES & LANCASTER
16, VICTORIA STREET, LONDON, S.W.



RIVETS, BOLTS, & SCREWS
Of all Descriptions and for all Purposes.
SEND FOR CATALOGUE.
T. D. ROBINSON & CO., Ltd.,
DERBY.

CAST-IRON
COLUMNS,
STANCHIONS AND GIRDERS.
Head, Wrightson & Co., Thornaby, Stockton-on-Tees.

PAGE'S WEEKLY Miscellaneous

PAGE'S WEEKLY Contracts

CONTRACTS.

BURY AND DISTRICT JOINT WATER BOARD.

TENDERS FOR CAST-IRON PIPES.

The Board invite **TENDERS** for the SUPPLY and DELIVERY of 3,000 yards (74 tons) of 4-in. diameter CAST-IRON TURNED and BORED PIPES.

Specification and Form of Tender may be obtained from the Engineer to the Board, Mr. J. CARTWRIGHT, Peel Chambers, Market Place, Bury, Lancs., on payment of £1, which amount will be returned on receipt of a *bona fide* Tender.

Tenders, sealed and marked "Tender for Cast-Iron Pipes," are to be delivered to the undersigned not later than Wednesday, November 15th, next.

Bank Street, Bury, October 10th, 1905. JOHN HASLAM, Clerk to the Board.

GREAT YARMOUTH UNION.—THE

Great Yarmouth Board of Guardians are prepared to receive TENDERS for the following:—

CONTRACT No. 1.—TWO STEEL LANCASHIRE BOILERS.

CONTRACT No. 3.—ONE SHALLOW WELL.

Specifications and all particulars may be obtained on application to Mr. W. J. CARPENTER, A.M.I.C.E., South Denes Road, Great Yarmouth, on deposit of a cheque for £1 1s., returnable on the receipt of a *bona fide* Tender.

Tenders (endorsed) to be addressed to "The Clerk, Great Yarmouth Board of Guardians," Queen Street, Great Yarmouth, and must be received by him through the post on or before noon on the 14th day of November, 1905.

The Great Yarmouth Board of Guardians do not bind themselves to accept the lowest or any Tender.

Great Yarmouth, October 23rd, 1905.

COUNTY OF LONDON.—TO ENGINEERS AND OTHERS.

The London County Council invites **TENDERS** for the SUPPLY, DELIVERY, and ERECTION of either SIX or TWELVE SELF-DISCHARGING STEEL COAL TRUCKS, of about 5 tons capacity.

Persons desiring to submit Tenders may inspect the Drawings and obtain the Specification, Bill of Quantities, Form of Tender, and other particulars at the County Hall, Spring Gardens, S.W., upon payment to the Cashier of the Council the sum of £2.

This amount will, after the Council or its Committee have come to a decision upon the Tenders received, but not before, be returned to the Tenderer, provided he shall have sent in a *bona fide* Tender, and not have withdrawn the same, but in no case will the fee be returned unless a *bona fide* Tender is submitted.

Full particulars of the work may be obtained on application at the County Hall, previously to the payment of the fee for the Specification, etc.

Tenders must be upon the official forms, and the printed instructions contained therein must be strictly complied with.

The contractors will be bound by the contract to pay to all workmen (except a reasonable number of legally bound apprentices) employed by them wages at rates not less and to observe hours of labour not greater than the rates and hours set out in the Council's list, and such rates of wages and hours of labour will be inserted in and form part of the contract by way of schedule.

Each Tender is to be delivered at the County Hall, in a sealed cover, addressed to the "Clerk of the London County Council, Spring Gardens, S.W.," and marked "Tender for Coal Trucks, Greenwich Generating Station."

No Tender will be received after 10 a.m. on Tuesday, the 14th day of November, 1905.

Any Tender which does not comply with the printed instructions for Tender may be rejected.

The Council does not bind itself to accept the lowest or any Tender, and it will not accept the Tender of any person or firm who shall on any previous occasion have withdrawn a Tender after the same had been opened, unless the reasons for the withdrawal were satisfactory to the Council.

G. L. GOMME, Clerk to the London County Council.

County Hall, Spring Gardens, S.W., October 25th, 1905.

TO CORRUGATED IRON BUILDING MANUFACTURERS.

The VISITING COMMITTEE of the SALOP and MONTGOMERY ASYLUM invite TENDERS for the ERECTION of a CORRUGATED IRON ISOLATION HOSPITAL on Foundations to be otherwise provided.

Plans and Specification may be obtained at my office on and after October 31st on payment of Two Guineas, which will be returned on receipt of a *bona fide* Tender.

Sealed Tenders, on the form supplied, endorsed "Hospital," must be delivered at my office not later than 10 a.m. on Tuesday, November 14th.

Power is reserved to reject the lowest or any Tender.

A. T. DAVIS, M.Inst.C.E.

Shirehall, Shrewsbury, October 20th, 1905.

STRATTON SEWAGE DISPOSAL.

TO SEWERAGE CONTRACTORS.

The HIGHWORTH RURAL DISTRICT COUNCIL hereby invite TENDERS for a STORM-WATER BED at their Outfall Works, in the Parish of Stratton St. Margaret, and Incidental Works, the whole to be let in one Contract.

Drawings and Specification may be seen at the Offices of the Engineers, Messrs. BEESLEY, SON, AND NICHOLS, M.M.Inst.C.E., 11, Victoria Street, Westminster, S.W., where also the Schedule of Quantities, Specification, and Form of Tender can be obtained on deposit of £2, which will be refunded by the Engineers on the return of all documents to them, and on the receipt by me of a *bona fide* Tender correctly based on the Schedule of Quantities fully priced out.

Sealed Tenders, addressed to me, and endorsed "Stratton Sewage Disposal—Storm-Water Bed," are to be delivered at my offices, 100, Victoria Road, Swindon, Wilts, on or before 10 a.m. on Wednesday, the 8th November, 1905.

The lowest or any Tender will not necessarily be accepted.

JOHN P. KIRBY, Clerk to the Rural District Council.

100, Victoria Road, Swindon, Wilts. September 30th, 1905.

EAST INDIAN RAILWAY.—THE EAST

Indian Railway Company is prepared to receive TENDERS for the SUPPLY and DELIVERY of:—

(1) WROUGHT IRON BARS.
(2) FIREBRICKS,

as per Specification to be seen at the Company's offices.

Tenders are to be sent to the undersigned, marked "Tender for Wrought Iron," or, as the case may be, not later than Twelve o'clock noon on Wednesday, the 8th day of November proximo.

The Company reserves to itself the right to divide the order, also to decline any Tender without assigning a reason, and does not bind itself to accept the lowest or any Tender.

For each Specification a fee of £1 1s. is charged, which cannot under any circumstances be returned.

By order, C. W. YOUNG, Secretary.

Nicholas Lane, London, E.C., October 26th, 1905.

METROPOLTITAN BOROUGH OF ISLINGTON.

TENDERS are invited for the SUPPLY and DELIVERY of GALVANISED WROUGHT-IRON SHINGLE BINS and CAST-IRON ORDERLY BINS.

A Specification and Drawing of the Shingle Bins, and a Specification and Sample of the Orderly Bins, may be seen, and a Form of Tender obtained upon application to the Borough Engineer, Mr. J. PATTEN BARBER, at the Town Hall, Upper Street, N., and payment of £2 2s., which will be returned upon receipt of a *bona fide* Tender and the return of all the documents issued.

Sealed Tenders, endorsed "Tenders for Bins," must be received by the undersigned not later than 4 p.m. on Tuesday, the 7th November, 1905.

The Council do not bind themselves to accept the lowest or any Tender.

WM. F. DEWEY, Town Clerk.

Town Hall, Upper Street, N., October, 1905.

BOROUGH OF BARROW-IN-FURNESS.

ELECTRICITY DEPARTMENT.

CONTRACT No. 16.

The Corporation are prepared to receive TENDERS for the Supply and Erection of—

Section A. One 500 kw. Combined Steam Engine and Generator.
" B. One Balancer Booster.
" C. Switchboard Panels and Connections for Generator and Booster.
" D. One Water-tube Boiler, with Superheater.
" E. One Mechanical Stoker.
" F. Steam and Exhaust Pipes, Valves, &c.
" G. One Economiser.
" H. Ironwork.
" I. One 15-Ton Travelling Crane.
" J. One Cooling Tower.

Complete Specifications may be obtained after the 23rd inst. from Mr. H. R. BURNETT, Electricity Works, Barrow-in-Furness, on payment of One Guinea, which will be returned upon receipt of a *bona fide* Tender.

Specifications and Drawings may also be seen upon application at the Electricity Works.

Sealed Tenders, endorsed "Contract No. 16, Section......," to be addressed to the Chairman, Electricity Committee, and delivered at my office not later than 12 noon on Monday, November 13th, 1905.

The Corporation do not bind themselves to accept the lowest or any Tender.

By order, C. F. PRESTON, Town Clerk.

Town Hall, Barrow-in-Furness.

PAGE'S WEEKLY Contracts and Appointments Open

CLACTON-ON-SEA URBAN DISTRICT COUNCIL.

The Urban District Council of Clacton-on-Sea are prepared to receive TENDERS for the Supply and Erection of the following :—

Section A. GAS ENGINES and DYNAMOS.
Section B. SWITCHBOARD.
Section C. UNDERGROUND MAINS.
Section D. ACCUMULATORS.
Section E. METERS.
Section F. CRANE.
Section G. BUILDINGS.

Tenderers are at liberty to Tender for any Section or Sections, but not for part of a Section.

Specification, with Terms and Conditions, may be obtained of Mr. W. H. TRENTHAM, 39, Victoria Street, Westminster, S.W., after Monday, the 23rd inst., on payment of £3 3s., which sum will be returned on receipt of a *bona fide* Tender.

Tenders must be addressed, sealed and marked "Tender for Electricity Works," to G. T. LEWIS, Esq., Clerk, Urban District Council, Clacton-on-Sea, and delivered at or before Three p.m. on Monday, the 6th day of November, 1905.

The Council do not bind themselves to accept the lowest or any Tender.

W. H. TRENTHAM,
Consulting Electrical Engineer.

METROPOLITAN BOROUGH OF SHOREDITCH.

ELECTRICITY SUPPLY DEPARTMENT.

The Mayor, Aldermen, and Councillors of the Metropolitan Borough of Shoreditch REQUIRE TENDERS for the EXTENSION of PLANT at their Whiston Street Generating Station.

The requirements include :—

CONTRACT NO 34.—3 Marine-type Water-tube Boilers, 1 Superheater, Foundations, etc.

CONTRACT NO. 35.—Steam Piping, Valves, Feed and Drain Pipes, etc.

CONTRACT NO. 36.—Overhead Steel Flue.

The Specification and General Conditions may be obtained on and after Tuesday, the 31st inst., at the Offices of the Borough Electrical Engineer, Coronet Street, N., on payment by cheque of £5 in respect of each Specification, which will be refunded on receipt of a *bonâ fide* Tender.

Tenders, sealed and endorsed (on the left-hand corner of the envelope) "Tender for ....," should be addressed to the Town Clerk, Town Hall, Old Street, E.C., and must be delivered not later than noon on the 7th day of November, 1905.

The Council does not bind itself to accept the lowest or any Tender.

H. M. ROBINSON, LL.D.,
Town Hall, Shoreditch. Town Clerk.

COUNTY BOROUGH OF ROCHDALE.

TO SEWER CONTRACTORS.

The Paving, etc., Committee of the Rochdale Corporation invite TENDERS for the CONSTRUCTION of about 120 lineal yards of 2 ft. 2 in. by 3 ft. 3 in. BRICK SEWER; 330 lineal yards of 1 ft. 6 in. by 2 ft. 3 in. BRICK SEWER; 185 lineal yards of 3 ft. 6 in. CIRCULAR BRICK SEWER, and 155 lineal yards of 2 ft. CIRCULAR IRON PIPE SEWER, with all Manholes, Valve Chambers, River Crossings etc., in connection therewith, from Entwistle Road, through private lands and under the L. and Y. Railway, to Minlow Road, within the said Borough.

Plans and Specifications may be seen and copies of the Quantities and Form of Tender obtained on and after Thursday, the 19th inst., on payment of a deposit of £3 3s. (which sum will be returned on receipt of a *bona fide* Tender, and the whole of the documents supplied), at the Office of Mr. S. S. PLATT, M.Inst.C.E., Borough Surveyor, Town Hall, Rochdale.

Tenders, endorsed "Contract No. 259," to be delivered at my office not later than noon on Wednesday, the 8th day of November, 1905.

The Committee do not bind themselves to accept the lowest or any Tender.

By order,
WM. HENRY HICKSON,
Town Hall, Rochdale, Town Clerk.
October 14th, 1905.

APPOINTMENTS OPEN.

CITY OF AUCKLAND, NEW ZEALAND.

APPOINTMENT OF CITY ENGINEER.

Applications, accompanied by Testimonials, will be received in the Town Clerk's Office, Auckland, New Zealand, until 4 o'clock p.m. on Thursday, February 8th, 1906, for the appointment of City Engineer to the City of Auckland. Conditions of appointment may be seen, and copies obtained, at the office of the High Commissioner for New Zealand, Westminster Chambers, 13, Victoria Street, London, S.W.

HENRY W. WILSON,
Town Clerk.

September 1st, 1905.

IRRIGATION ENGINEER REQUIRED FOR SERVICE IN CEYLON.

Candidates should be competent surveyors, and correct levellers and draughtsmen, and have had considerable experience of engineering works.

The person engaged will be required to make preliminary and final surveys and sections of irrigation work, make plans and take out the quantities and prepare estimates therefor, and supervise the construction and carrying out of irrigation schemes.

Engagement for three years, the first year on probation.

Salary Rs. 4,000, with a travelling allowance of Rs. 600 per annum, and if engagement renewed salary increased to Rs. 5,000.

Second-class passages by mail steamer, or first-class by any other steamer for self and family (if any), not exceeding five persons in all, out and home again, on satisfactory termination of engagement.

Strict medical examination.

Application by letter (no special form required), stating age, whether married or single, number of children (if any), full particulars of experience, and accompanied by copies of testimonials (not originals), with names and addresses of referees of whom inquiry can be made as to qualifications and personal character, will be received by the Crown Agents for the Colonies, Whitehall Gardens, London, S.W., up to November 8th.

The following reference, M-2292, on the top left-hand corner of the letter of application should be made.

BY ORDER OF THE SECRETARY OF STATE FOR INDIA IN COUNCIL.

INDIAN STATE RAILWAYS.

Wanted, for the service of the Government of India, a thoroughly practical man, with up-to-date knowledge, to generally ASSIST the SUPERINTENDENT of the CARRIAGE and WAGON DEPARTMENT of the North-Western Railway of India in the Design and Construction of Railway Carriages and Wagons.

Five years' agreement in the first instance.

Salary to commence at 450 rupees per month, rising by increments of 50 rupees per month yearly to a maximum of 600 rupees per month.

First-class passage out and home.

Age 25 to 35.

Forms of application and further particulars can be obtained by writing to the Director-General of Stores, India Office, Whitehall, London, S.W., not later than November 13th, 1905.

E. GRANT BURLS,
Director-General of Stores.

India Office,
Whitehall, London, S.W.,
October 26th, 1905.

BOROUGH OF IPSWICH.—ENGINEER AND MANAGER OF WATERWORKS.

The Corporation of Ipswich invite APPLICATIONS for the POST of ENGINEER and MANAGER of their Waterworks. The person appointed will be required to take entire charge of the works, pumping station, and reservoirs, design and carry out extensions of mains and plant, and generally superintend the water supply of the town under the directions of the Waterworks Committee. He must devote his whole time to the duties of his office, and not engage in any other occupation.

The salary will commence at £250 per annum.

Applications, with not more than three recent testimonials as to fitness, to be sent to me before Thursday, November 16th, 1905.

Canvassing in any form will disqualify.

WILL. BANTOFT,
Town Clerk.

Town Hall, Ipswich,
October 19th, 1905.

COLWYN BAY AND COLWYN URBAN DISTRICT COUNCIL.

ENGINEER-IN-CHARGE.

The Colwyn Bay and Colwyn Urban District Council will shortly REQUIRE a fully qualified MECHANICAL ENGINEER to take charge of their Sewage Pumping Station, containing gas engines, pumps, and other machinery, including full workshop equipment, lathe, etc.

Candidates must have had experience of a similar character, and be capable of taking and recording the customary particulars appertaining to such work, and making the usual reports.

The Council will provide a house, gas, and water free.

Applications, in own handwriting, stating age, present wages and wages required, date they could commence their duties, together with full particulars of present and previous occupation and qualifications, accompanied by copies of Testimonials (which will not be returned) and of certificates, are to be delivered to Mr. ROBERT GREEN, A.M.I.C.E., Engineer of the Colwyn Bay Sewerage Works, 37, Waterloo Street, Birmingham, not later than Thursday, the 9th of November, endorsed, Engineer-in-Charge."

Canvassing will be a disqualification.

JAMES AMPHLETT,
Council Offices, Colwyn Bay, Clerk to the Council.
October 18th, 1905.

BUYERS' DIRECTORY.

NOTE.—*The display advertisements of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index to Advertisers on pages 22 and 24.*

In order to assure fair treatment to advertisers, each firm is indexed under its leading speciality ONLY.

Advertisers who prefer, however, to be entered under two or more different sections can do so by an annual payment of 5s. for each additional section.

Advertisers' Service Bureau.
British Advertiser Service Bureau, Queen Anne's Chambers, Westminster, S.W.

Artesian Well Machinery.
John Z. Thom, Patricroft, Manchester.

Band Sawing Machines.
Noble & Lund, Ltd., Felling-on-Tyne.

Bearings (Roller).
Hyatt Roller Bearing Co., 47, Victoria Street, London, S.W.

Belting.
Binney & Son, Catherine Street, City Road, London, E.C.
Cort, Arthur, & Co., Camberwell, London, S.E.
Fleming, Birkby & Goodall, Ltd., West Grove, Halifax.
Gilmour, W. & O., St. John's Hill, Edinburgh.

Boilers.
Clayton, Son & Co., Ltd., Leeds City Boiler Works, Leeds.
Grantham Boiler and Crank Co., Ltd., Grantham.
Hartley & Sugden, Ltd., Halifax.
Thompson, John, Wolverhampton.

Boilers (Water-tube).
Babcock & Wilcox, Ltd., Oriel House, Farringdon Street, London, E.C.
Stirling Boiler Co., Ltd., Motherwell, N.B.

Bolts, Nuts, Rivets, etc.
Herbert W. Periam, Ltd., Floodgate Street Works, Birmingham.
T. D. Robinson & Co., Ltd., Derby.

Books.
Griffin, Charles, & Co., Exeter Street, Strand, W.C.
New Zealand Mines Record, Wellington, New Zealand.
Spon, E. & F. N., 125, Strand, W.C.

Boring Machines.
Asquith, William, Ltd., Well Road Works, Halifax.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Noble & Lund, Ltd., Felling-on-Tyne.

Case-Hardening Compounds.
Hy. Miller & Co., Millgarth Works, Leeds.

Castings.
Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees.

Catalogues, Printing, &c.
Atlantic Press, Ltd., Weymouth Street, Manchester.
Spottiswoode Advertising Agency, Clun House, Surrey Street, Strand, W.C.
Stafford, Arthur, & Co., Denton, Manchester.

Chucks.
Fairbanks Co., 78-80, City Road, London, E.C.

Cisterns, Tanks, &c.
Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Clutches (Friction).
David Bridge & Co., Castleton Ironworks, Rochdale, Lancashire.

Coke Oven Expert.
Mallmann, P. J., 110-118, Victoria Street, S.W.

Condensing Plant.
Benn, Sykes, Haslingden, near Manchester.
Concentric Condenser, Ltd., 23, Northumberland Avenue, London, W.C.
Mirrlees-Watson & Co., Ltd., Glasgow.

Consulting Engineers.
Gibbs, John, & Son, 80, Juke Street, Liverpool.
G. H. Hughes, A.M.I.M.E., 19, Old Queen Street, Westminster, S.W.
Melville & Macalpine, 615, Walnut Street, Philadelphia, Pa., U.S.A.
Mount-Haes, A., M.I.Mech.E., M.I.M.E., 11, Ironmonger Lane, London, E.C.

Continental Railway Arrangements.
Northern Railway of France.
South Eastern & Chatham Railway Co.

Conveying and Elevating Machinery.
Adolf Bleichert & Co., Leipzig-Gohlis, Germany.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
Temperley Transporter Co., 72, Bishopsgate Street Within, London, E.C.

Coverings (Boiler).
Magnesia Covering Ltd., Washington Station, co. Durham.

Cranes, Travellers, Winches, etc.
Joseph Booth & Bros. Ltd, Rodley, Leeds.
Thomas Broadbent & Sons, Ltd., Huddersfield.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.

Cranks.
Clarke's Crank & Forge Co., Ltd., Lincoln, England.

Cutters (Milling).
Pratt & Whitney Co., 23-25, Victoria Street, London, S.W.
E. G. Wrigley & Co., Ltd., Foundry Lane Works, Soho, Birmingham.

Destructors.
Heenan & Froude, 4, Chapel Walks, Manchester.
Horsfall Destructor Co., Ltd., Armley, Leeds.

Dredges and Excavators.
Delange & Cie, Mce., Hoboken, near Antwerp.
Rose, Downs & Thompson, Ltd., Old Foundry, Hull.

Drilling Machines.
Asquith, William, Ltd., Well Road Works, Halifax.
Niles-Bement-Pond Co., 23-25, Victoria Street, London S.W.
Noble & Lund, Ltd., Felling-on-Tyne.
Swift, George, Claremont Ironworks, Halifax.

Economisers.
E. Green & Son, Ltd., Manchester.

Ejectors (Pneumatic).
Hughes & Lancaster, 16, Victoria Street, London, S.W.

Electrical Apparatus.
Allgemeine Elektricitäts Gesellschaft, Berlin, Germany.
British Westinghouse Electric and Manufacturing Co., Ltd., Norfolk Street, Strand, London, W.C.
Broadbent, T. W., Victoria Electrical Works, Huddersfield.
Crypto Electrical Co., 3, Tyer's Gateway, Bermondsey Street, London, S.E.
Ebonestos Manufacturing Co., 22, Rosoman Street, London, E.C.
Gent & Co., Ltd., Faraday Works, Leicester.
Greenwood & Batley, Ltd., Albion Works, Leeds.
India Rubber, Gutta Percha, and Telegraph Works Co., Ltd., Silvertown, London, E.
Matthews & Yates, Ltd., Swinton, Manchester.
Mix and Genest, Berlin, W., Germany.
Nalder Bros. & Thompson, 34, Queen Street, London, E.C.
New Gutta Percha Co., Ltd., Dashwood House, New Broad Street, E.C.
Newton Brothers, Full Street, Derby.
Phœnix Dynamo Manufacturing Co., Bradford, Yorks.
Scott, E., & Mountain, Ltd., Newcastle-on-Tyne.
Sturtevant Engineering Co., Ltd., 147, Queen Victoria Street, London, E.C.
Turner, Atherton & Co., Ltd., Denton, Manchester.
B. Weaver & Co. (*see* Ebonestos Manufacturing Co.), 22, Rosoman Street, Clerkenwell, London, E.C.

Engineers' Supplies.
Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.

Engines (Gas).
Campbell Gas Engine Co., Ltd., Halifax.
Cundall, Son & Co., Ltd., Airedale Iron Works, Shipley.

Engines (Electric Lighting).
McLaren, J. and H., Midland Engine Works, Leeds.

Engines (Locomotive).
Baldwin Locomotive Works, Philadelphia, Pa., U.S.A.
Hunslet Engine Co., Ltd., Leeds, England.
Hudswell, Clarke & Co., Ltd., Leeds, England.
McLaren, J. & H., Midland Engine Works, Leeds.

Engines (Portable).
Garrett, R., & Sons, Leiston, R.S.O., Suffolk.

Engines (Stationary).
Allis-Chalmers Co., 533, Salisbury House, Finsbury Circus, London E.C.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
Garrett, R., & Sons, Leiston, R.S.O., Suffolk.
Mirrlees Watson Co., Ltd., Glasgow.

Engines (Traction).
Jno. Fowler & Co. (Leeds), Ltd., Steam Plough Works, Leeds.
Garrett & Sons, Ltd., Richard, Leiston, R.S.O., Suffolk.

Engravers.
Jno. Swain & Son, Ltd., 58, Farringdon Street, London, E.C.

Exhaust Steam Oil Separators.
Lancaster & Tonge, Ltd., Pendleton, Manchester.

Fans, Blowers.
Capel Fan Co., 13, Moseley Street, Newcastle-on-Tyne.
Davidson & Co., Ltd., "Sirocco" Engineering Works, Belfast, Ireland.
Gibbs, John & Son, 80, Juke Street, Liverpool.
James Keith & Blackman Co., Ltd., 27, Farringdon Avenue, London, E.C.
Matthews & Yates, Ltd., Swinton, Manchester.

Fire Bricks.
J. H. Sankey & Son, Ltd., Essex Wharf, Canning Town, London, E.

PAGE'S WEEKLY Aerial Ropeways

Buyers' Directory—(*Continued*).

Firewood Machinery.
M. Glover & Co., Patentees and Saw Mill Engineers, Leeds.

Fountain Pens.
Mabie, Todd & Bard, 93, Cheapside, London E.C.

Forging (Drop) Plants.
Brett's Patent Lifter Co., Ltd., Coventry.

Forgings (Drop).
J. H. Williams & Co., Brooklyn, New York, U.S.A.

Furnaces.
Deighton's Patent Flue & Tube Company, Vulcan Works, Pepper Road, Leeds.
Leeds Forge Co., Ltd., Leeds.
Masons Gas Power Co., Ltd., Alma Works, Levenshulme, Manchester.

Gas Producers.
Masons Gas Power Co., Ltd., Alma Works, Levenshulme, Manchester.

Gauge Glasses.
J. B. Treasure & Co., Vauxhall Road, Liverpool.
Tomey, J., & Sons, Aston, Birmingham.

Gauges (Pressure, Vacuum, and Hydraulic).
Dobbie, McInnes, Ltd., 45, Bothwell Street, Glasgow.

Gearing.
Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.
Angus, G. & Co., Ltd., Newcastle-on-Tyne.
Asquith, William, Ltd., Well Road Works, Halifax.
Reid Gear Co., Linwood, near Glasgow.
Wild, M. B., & Co., Corporation Street, Birmingham.

Gold Dredging Plant.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.

Greases.
Blumann and Stern, Ltd., Plough Bridge, Deptford, London, S.E.

Hack Saws.
Baynes, Charles, Knuzden Brook, Blackburn.

Hammers (Steam).
Davis & Primrose, Leith Ironworks, Edinburgh.
Niles-Bement Pond Co., 23-25, Victoria Street, London, S.W.

Hoisting Machinery.
See Conveying Machinery.

Horizontal Boring Machines.
Asquith, William, Ltd., Well Road Works, Halifax.
Greenwood & Batley, Albion Works, Leeds.
Niles-Bement Pond Co., 23-25, Victoria Street London, S.W.
Noble & Lund, Ltd., Felling-on-Tyne.

Hydraulic Leather.
Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.

Hydraulic Machine Tools.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Vauxhall and West Hydraulic Engineering Co. Ltd., 23, College Hill, London, E.C.

Icemaking and Refrigerating Machinery.
H. J. West & Co., 114-118, Southwark Bridge Road, London, S.E.

Indicators.
Dobbie McInnes, Ltd., 45, Bothwell Street, Glasgow.
Hannan & Buchanan, 75, Robertson Street, Glasgow.

Iron and Steel.
Allen, Edgar, & Co. Ltd., Imperial Steel Works, Sheffield.
Askham Bros. & Wilson, Ltd., Sheffield.
Consett Iron Co., Ltd., Consett, Durham, and Newcastle-on-Tyne.
Fairley & Sons, James, Old Mint, Shadwell Street, Birmingham.
Farnley Iron Co., Ltd., Leeds. England.
Fried. Krupp, Grusonwerk, Magdeburg-Buckau, Germany.
J. Frederick Melling, 14, Park Row, Leeds, England.
Parker Foundry Co., Derby.
Purden, John & Sons, Lambhill Forge, by Maryhill, Glasgow.
Walter Scott, Ltd., Leeds Steel Works, Leeds, England.

Ironwork (Constructional).
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Ironwork (Galvanised).
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Lagging Sheets.
Zeitz & Co., 21, Lime Street, London, E.C.

Lathes.
Asquith, William, Ltd., Well Road Works, Halifax.
Bradbury & Co., Ltd., Wellington Works, Oldham.
Eclipse Tool Manufacturing Co., Linwood, near Glasgow.
Leckenby, Benton, & Co., Perseverance Ironworks, Halifax.
Mitchell, D., & Co., Ltd., Parsonage Works, Keighley.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Noble & Lund, Ltd., Felling-on-Tyne.
Northern Engineering Co. (1900), Ltd., King Cross, near Halifax.
Swift, George, Claremont Ironworks, Halifax.

Lathe Carriers.
Williams, J. H., & Co., Brooklyn New York, U.S.A.

Laundry Machinery.
W. Summerscales & Sons, Ltd., Engineers, Phœnix Foundry, Keighley, England.

Lifts.
Waygood & Co., Ltd., Falmouth Road, London, S.E.

Lubricants.
Blumann & Stern, Ltd., Plough Bridge, Deptford, London, S.E.
Reliance Lubricating Oil Co., The, 19 & 20, Water Lane, Great Tower Street, London, E.C.
Matthew Wells & Co., Hardman Street Oil Works, Manchester.

Machine Tools.
Asquith, William, Ltd., Well Road Works, Halifax.
George Addy & Co., Waverley Works, Sheffield.
Bateman's Machine Tool Co., Hunslet, Leeds.
Beanland, Perkin, & Co., School Close Works, Leeds.
Bertrams, Ltd., St. Katherine's Works, Sciennes, Edinburgh.
Bradbury & Co., Ltd., Wellington Works, Oldham.
Breuer, Schumacher & Co., Ltd., Kalk, near Cologne-on-Rhine (Germany).
Consolidated Pneumatic Tool Co., Ltd, Palace Chambers, 9, Bridge Street, Westminster, S.W.
Cunliffe & Croom, Ltd., Broughton Ironworks, Manchester.
Dean, Smith & Grace, Ltd., Keighley.
Fengl, A., & Co., Grafton Street, Altrincham.
Greenwood & Batley, Ltd., Leeds.
Jones & Lamson Machine Co., 97, Queen Victoria Street, London, E.C.
John Lang & Sons, Johnstone, near Glasgow.
Luke & Spencer, Ltd., Broadheath, Manchester.
Jos. C. Nicholson Tool Co., City Rd. Tool Wks., Newcastle-on-Tyne.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Noble & Lund, Ltd., Felling-on-Tyne.
Northern Engineering Co., 1900, Ltd., King Cross, near Halifax.
J. Parkinson & Son, Canal Ironworks, Shipley, Yorkshire.
C. Redman & Sons, Halifax.
Resides, 12, Aire Street, Brighouse, Yorks.
Rice & Co. (Leeds), Ltd., Leeds, England.
G. F. Smith, Ltd., South Parade, Halifax.
Swift, George, Claremont Ironworks, Halifax.
Taylor and Challen, Ltd., Derwent Foundry, Constitution Hill, Birmingham.
Vauxhall and West Hydraulic Engineering Co., Ltd., 23, College Hill, London, E.C.
H. W. Ward & Co., Lionel Street, Birmingham.
T. W. Ward, Albion Works, Sheffield.
West Hydraulic Engineering Co. (see Vauxhall and West Hydraulic Engineering Co. Ltd.), 23, College Hill, London, E.C.
Winn, Charles, & Co., St. Thomas Works, Birmingham.
Yorkshire Machine Tool and Engineering Works, Liversedge, Yorks.

Marks.
Pryor, Edward, & Son, 68, West Street, Sheffield.

Metals.
Delta Metal Co., Ltd., East Greenwich, London, S.E.
Magnolia Anti-Friction Metal Co., Ltd., of Great Britain, 49, Queen Victoria Street, London, E.C.
Phosphor Bronze Co., Ltd., Southwark, London, S.E.

Metals (Perforated).
W. Barns & Son, Chalton Street, Euston Road, London, N.W.
Brown, Andrew, & Co., 110, Cannon Street, London, E.C.
Méguin, Fr., & Co., Ltd., Engineering Works, Dillingen-on-Saar.

Mining Machinery.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.

Office Appliances.
Halden & Co., J., 8, Albert Square, Manchester.
Hall & Co., B. J., 39, Victoria Street, London, S.W.
Inglesant, T., & Sons, Ltd., Atlas House, Leicester.
Lyle Co., Ltd., Harrison Street, Gray's Inn Road, London, W.C.
Rockwell-Wabash Co., Ltd., 69, Milton Street, London, E.C.
Shannon, Ltd., Ropemaker Street, London, E.C.
Trading and Manufacturing Co., Ltd., Temple Bar House, Fleet Street, London, E.C.

Oils, &c.
Blumann and Stern, Ltd., Plough Bridge, Deptford, London, S.E.
Wells, M., & Co., Hardman Street Oil Works, Manchester.

Oil Filters and Cabinets.
Valor Co., Ltd., Rocky Lane, Aston Cross, Birmingham.

Packing.
Beldam Packing & Rubber Co., 93-94, Gracechurch Street, London, E.C.
Frictionless Engine Packing Co., Ltd., Hendham Vale Works, Harpurhey, Manchester.
Lancaster & Tonge, Ltd., Pendleton, Manchester.
Redfern & Co., S., Swan Lane, New Brown Street, Manchester.
Quaker City Rubber Co., Coronation House, Lloyd's Avenue, E.C.
United States Metallic Packing Co., Ltd., Bradford.
J. Bennett von der Heyde, 6, Brown Street, Manchester.

Paper.
Lepard & Smiths, Ltd., 29, King Street, Covent Garden, London, W.C.

Patent Agents.
Page & Rowlingson, 28 New Bridge Street, London, E.C.

Buyers' Directory—(*Continued*).

Photo Copying Frames.
J. Halden & Co., 8, Albert Square, Manchester.
B. J. Hall & Co., 39, Victoria Street, London, S.W.

Photographers.
Booker & Sullivan, 67 and 69, Chancery Lane, W.C.
Elliott & Fry, 55, Baker Street, London, W.

Photographic Apparatus.
Marion & Co., Ltd., 22 and 23, Soho Square, London, W.

Pinch Bars.
Samson & Co., Garforth, near Leeds.

Pipe Wrenches (Chain).
Williams, J. H., & Co., Brooklyn, New York, U.S.A.

Pistons.
Lancaster & Tonge, Ltd., Pendleton, Manchester.

Planished Sheets.
Zeitz & Co., 21, Lime Street, London, E.C.

Porcelain.
Gustav Richter, Charlottenburg, near Berlin, Germany.

Presses (Hydraulic).
Greenwood & Batley, Albion Works, Leeds.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.

Publishers.
Charles Griffin & Co., Ltd., Exeter Street, Strand, London, W.C.
Spon, E. and F. N., 125, Strand, W.C.
New Zealand Mines Record, Wellington, New Zealand.

Pumps and Pumping Machinery.
Drum Engineering Co., 27, Charles Street, Bradford.
Enke, Carl, Schkeuditz-Leipzig, Germany.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
J. P. Hall & Sons, Ltd., Peterborough.
Hathorn, Davey & Co., Ltd., Leeds, England.
Positive Rotary Pumps, Ltd., 23, Northumberland Avenue, London, W.C.
Tangyes, Ltd., Cornwall Works, Birmingham.

Radial Drilling Machines.
Asquith, William, Ltd., Well Road Works, Halifax.
Greenwood & Batley, Albion Works, Leeds.
M[illegible], D. & Co., Ltd., P[illegible] Works, Keighley.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Noble & Lund, Ltd., Felling-on-Tyne.
Northern Engineering Co. (1900), Ltd., King Cross, near Halifax.
Swift, George, Claremont Ironworks, Halifax.

Rails.
Wm. Firth, Ltd., Leeds.

Railway Wagons.
Nye, A. W., 110, Cannon Street, London, E.C.
W. R. Renshaw & Co., Ltd., Phœnix Works, Stoke-on-Trent.

Riveted Work.
F. A. Keep, Juxon & Co., Forward Works, Barn Street, Birmingham.

Roller Bearings.
Hyatt Roller Bearing Co., 47, Victoria Street, London, S.W.

Roofs.
D. Anderson & Son, Ltd., Lagan Felt Works, Belfast.
Head, Wrightson & Co., Ltd., Thornaby-on-Tees.

Ropeways (Aerial).
Bullivant & Co., Ltd., 72, Mark Lane, London, E.C.

Scientific Instruments.
Cambridge Scientific Instrument Co., Ltd., Cambridge.

Spanners.
Williams, J. H., & Co., Brooklyn, New York, U.S.A.

Stampings.
Thomas Smith & Sons of Saltley, Ltd., Birmingham.
Williams, J. H., & Co., Brooklyn, New York, U.S.A.

Stamps (Rubber).
Rubber Stamp Co., 1 & 2, Holborn Buildings, Broad Street Corner, Birmingham.

Stamps (Metal).
Edward Pryor & Son, 68, West Street, Sheffield.

Steam Traps.
British Steam Specialties, Ltd., Fleet Street, Leicester.
Lancaster & Tonge, Ltd., Pendleton, Manchester.

Steam Wagons.
Thornycroft & Co., Ltd., J. I., Chiswick, London, W.
Yorkshire Patent Steam Wagon Co., Pepper Road, Hunslet, Leeds.

Steel Tools.
Saml. Buckley, St. Paul's Square, Birmingham.
Pratt & Whitney Co., 23-25, Victoria Street, London, S.W.

Steel Structures.
Ashmore, Benson, Pease & Co., Ltd., Stockton-on Tees.

Stokers.
Ed. Bennis & Co., Ltd., Bolton, Lancs.

Stone Breakers.
S. Pegg & Son, Alexander Street, Leicester.

Superheaters.
A. Bolton & Co., 40, Deansgate, Manchester.

Time Recorders.
Howard Bros., 40, Paradise Street, Liverpool, and 10b, Queen Victoria Street, London, E.C.
Recorders, Ltd., 171, Queen Victoria Street, London, E.C.

Tubes.
Thomas Piggott & Co., Ltd., Spring Hill, Birmingham.
Tubes, Ltd., Birmingham.

Turbines.
Greenwood & Batley, Albion Works, Leeds.
S. Howes Co., 64, Mark Lane, London, E.C.

Typewriters.
Empire Typewriter Co., 77, Queen Victoria Street, London, E.C.
Yost Typewriter Co., 50, Holborn Viaduct, London, E.C.

Valves.
Holmes & Co., W. C., Huddersfield.
Hopkinson, J. & Co., Ltd., Britannia Works, Huddersfield.
Hunt & Mitton, Crown Brass Works, [illegible] Street North, Birmingham.
Scotch and Irish Oxygen Co., Ltd., R[illegible] Works, Glasgow.
Shaw, Joseph, Albert Works, Huddersfield.
Wian, Charles, & Co., St. Thomas Works, Birmingham.

Ventilating Appliances.
Matthews & Yates, Ltd., Swinton, Manchester.

Water Softeners and Purifiers.
Lassen & Hjort, 52, Queen Victoria Street, London, E.C.

Wagons—Steam.
Thornycroft & Co., J. I., Ltd., Chiswick, London, W.

Weighing Apparatus.
W. & T. Avery, Ltd., Soho Foundry, Birmingham, England.
Samuel Denison & Son, Hunslet Moor, near Leeds.

Wells Light.
A. C. Wells & Co., 100A, Midland Road, St. Pancras, London, N.W.

Wire Working Machinery.
Ed. Brand, 35, Shakespeare Street, Manchester.

"Woodite."
"Woodite" Company, Mitcham [illegible].

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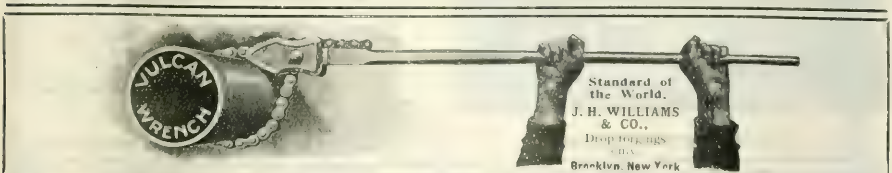

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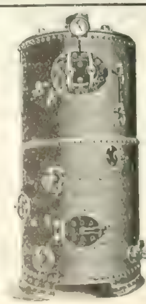

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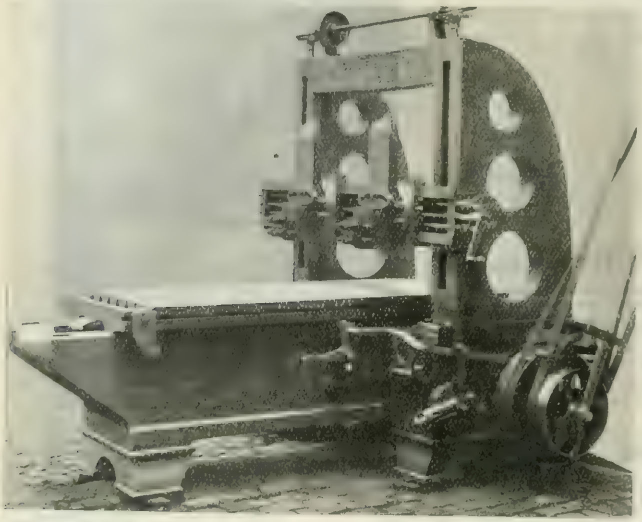

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PAGE'S WEEKLY — Machine Tools

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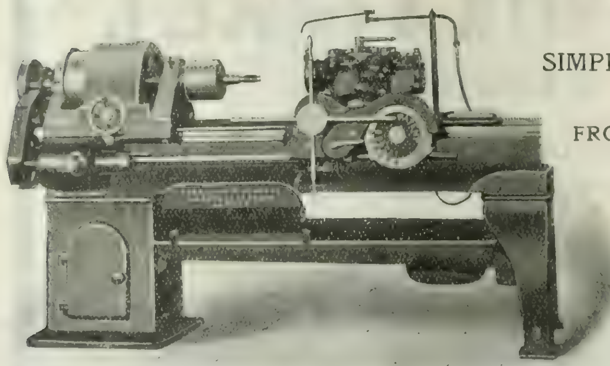

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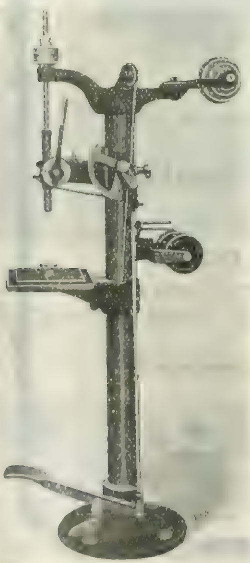

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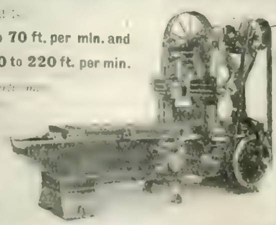

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BATEMAN'S MACHINE TOOL CO., Ltd.,
Hunslet, LEEDS.

HIGH-SPEED LATHES

OUR SPECIALITY.

HIGH-GRADE MACHINES

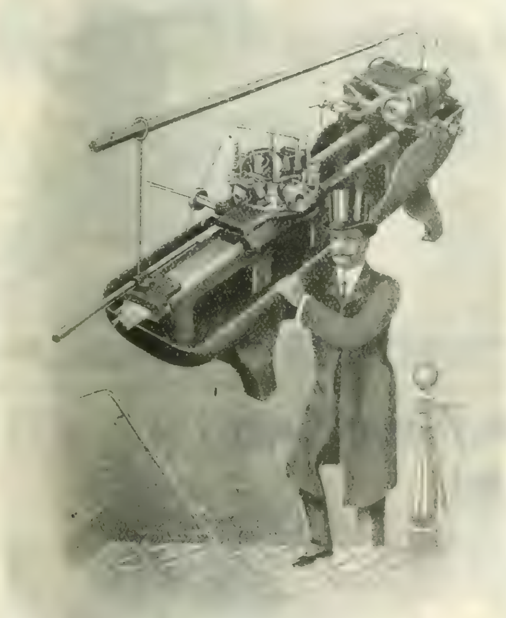
only, in stock for Immediate Delivery.

(Established 1871.)

C. REDMAN & SONS, Parkinson Lane, HALIFAX.

PAGE'S WEEKLY — Machine Tools

It would be Impossible



For our Representative to carry a machine on his shoulder

when he comes to interview you regarding the purchase of a Hartness Flat Turret Lathe,

But, if you will call at our premises,

97, Queen Victoria Street, London, one of our expert operators will take very great pleasure in demonstrating to you the merits of our New Model Hartness Flat Turret Lathe, with Cross Sliding Head,

☛ The only Turret Lathe of the kind on the Market.

COME AND SEE IT WORKING.

JONES & LAMSON MACHINE CO.,

"Jubilee Buildings," 97, Queen Victoria Street, LONDON, England.

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PAGE'S WEEKLY **Machine Tools**

GEORGE SWIFT

CLARENCE IRON WORKS · *HALIFAX, England.*

Telephone No. 467 Telegrams "Swiftly, Halifax." Established [illegible]

Slotting Machines

From 6 in. to 18 in. Stroke.

Complete Catalogue on request.

These Machines are exceptionally rigid on the table and slides, and have lately been redesigned.

8 in., 10 in., and 12 in. Machines always in progress.

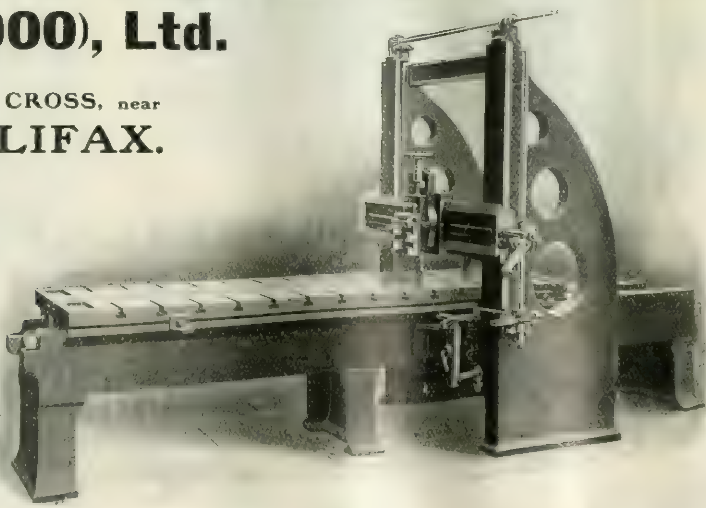
Accompanying illustration is of my **8 in. STROKE MACHINE,** with Balanced Ram, Quick Return, and Centring Table. Shall be glad to submit full particulars of this or any other of my tools on application.

INQUIRIES SOLICITED.

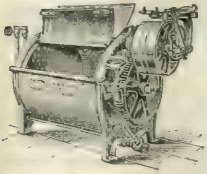
Northern Engineering Co. (1900), Ltd.

KING CROSS, near
HALIFAX.

6' PLANING MACHINE, from 2 feet up to 8 feet square.



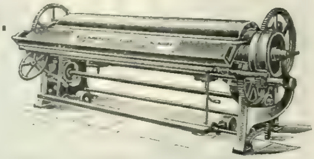
PAGE'S WEEKLY Machine Tools, &c.



LAUNDRY

MACHINERY

and Steam COOKING APPARATUS.



Please write for our New Catalogue, **N.**

Summerscales, Ltd., KEIGHLEY, ENGLAND.

THE

JOS. C. NICHOLSON TOOL CO.

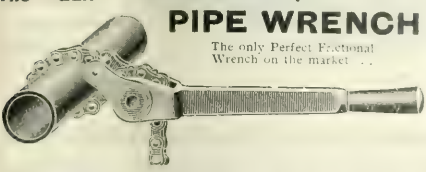
Machine Tool Makers, NEWCASTLE-ON-TYNE.

Sole Proprietors and Makers of

The "BEAR" Patent Smooth Grip

PIPE WRENCH

The only Perfect Frictional Wrench on the market . .



LANG'S LATHES

ARE NOW MADE IN

New Workshops

Replete with the Highest Class of Tools.

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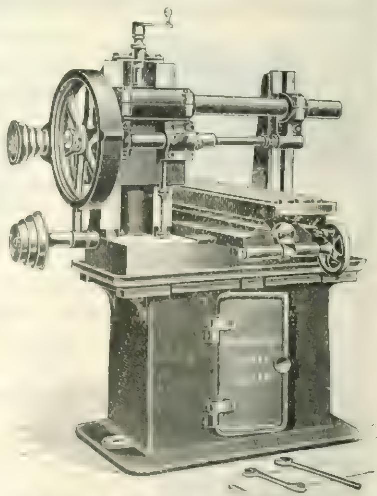
JOHN LANG & SONS, Johnstone, nr. Glasgow.

BRADBURY'S

Newly Designed

Standard Milling Machine



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SPEED,
ACCURACY,
ADAPTABILITY,

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Prices and Particulars from - -

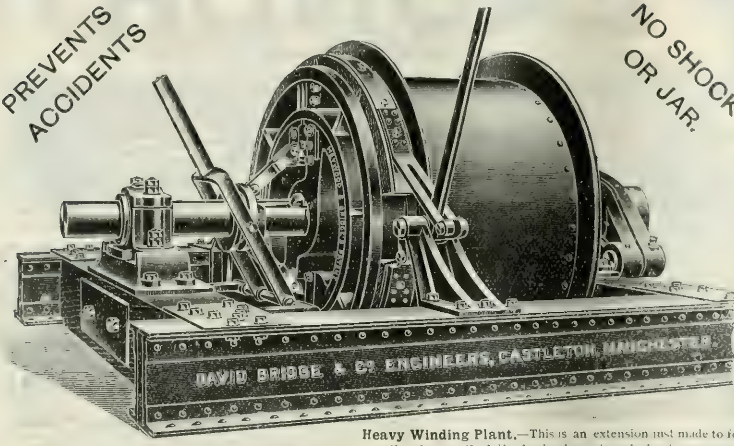
BRADBURY & Co., Ltd., *Wellington Works,* *OLDHAM.*

PAGE'S WEEKLY Miscellaneous

HEYWOOD & BRIDGE'S Improved Patent Friction Clutches.

PREVENTS ACCIDENTS

NO SHOCK OR JAR.



Heavy Winding Plant.—This is an extension just made to four other drums—the latter having been at work about seven years.

Complete Clutch, Gearing and Hauling Plants our Speciality.

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Quotations on application for Complete Plants.

Patentees and Sole Makers :—

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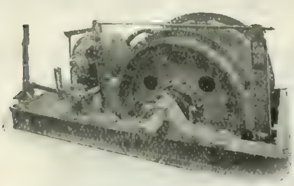
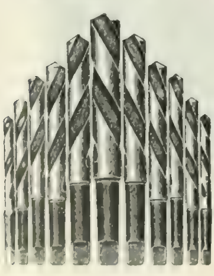
London Office: 35, QUEEN VICTORIA STREET, E.C.

Electric Hauling GEARS



Main and Tail Main Rope, Endless Rope and Portable, Hoisting, and Hauling Gears.

M. B. WILD & CO., 35 and 36, Clarence Chambers, Corporation Street, BIRMINGHAM.



Twist Drills, Taps, Milling Cutters, Reamers.

H. F. SCHNICKE, CHEMNITZ (Saxony).

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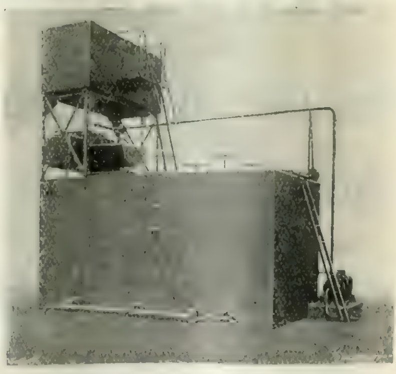


Water Purification is our Speciality.

1,600 PLANTS in Operation.

LASSEN & HJORT,

Engineers,

52, QUEEN VICTORIA STREET.

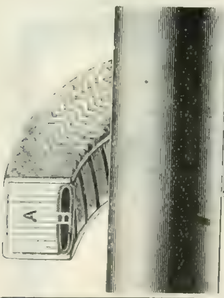
Telephone [illegible] Central. Telegrams "Tentworth, London."

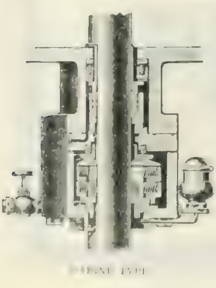
Index to Advertisers.

Advertisements not appearing this week will be found by reference to the preceding or following issues, with the exception of those appearing monthly.

PAGE'S WEEKLY Miscellaneous

Index to Advertisers—(Contd.)

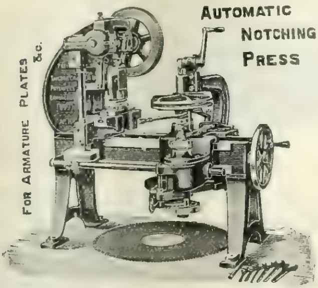


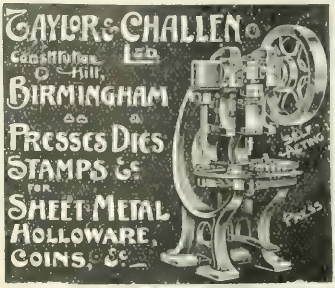


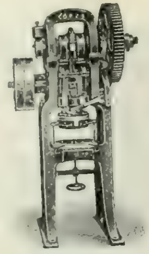
PAGE'S WEEKLY Miscellaneous

AUTOMATIC NOTCHING PRESS

FOR ARMATURE PLATES &c.







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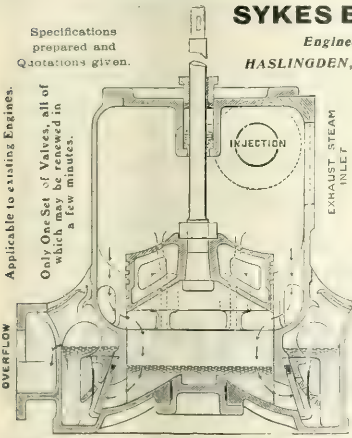
SYKES BENN,
Engineer,
HASLINGDEN, LANCS.

Specifications prepared and Quotations given.

Applicable to existing Engines.

Only One Set of Valves, all of which may be renewed in a few minutes.



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Steam, Electric, Rope, or Belt-Driven.

INDEPENDENT
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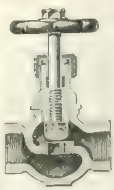
104, Bath Street.

The "SHAW" Patent Steam Valves . .



With Renewable Seats, Interchangeable Concentric Valve, Compound Packing to Spindle, Special Metal, and High-Class Workmanship.

The "SHAW" Patent Parallel Slide Valve is the Acme of Simplicity and Durability.

Try Them ! Sent on Approval.

☞ *Write for particulars of these and other Specialities for High Pressure Steam.*

JOSEPH SHAW, B Dept., Albert Works, HUDDERSFIELD.

HIGH-CLASS LUBRICANTS

FOR MACHINERY OF EVERY DESCRIPTION.

LAND and MARINE ENGINE and CYLINDER OILS.

DYNAMO and GAS ENGINE OILS.

CRANK CHAMBER and STEAM TURBINE OILS.

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SOLIDIFIED OILS and GREASES for all PURPOSES.

BLUMANN & STERN, LTD., Plough Bridge, Deptford, LONDON, S.E.

Contractors to H.M. Government, Home, and Foreign Railways, &c.

PAGE'S WEEKLY Packings, Lubricants, &c.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

Vol. VII. LONDON, FRIDAY, NOVEMBER 3, 1905. No. 60.

The Offices of "Page's Weekly," Wednesday Evening.

THE Barry Railway Company are to be congratulated on having secured as their general manager one whose ripe experience eminently qualifies him for the position. A native of Leeds, Mr. Edward Lake began his business career on the North Eastern Railway as a junior clerk in the office of the Southern district mineral manager. In 1890 he became head of the department, and, having occupied that position for two years, was made goods and mineral manager of the Hull District. On the amalgamation in 1893 of the Hull Dock Company with the North Eastern Railway, he assumed the additional responsibilities of the management of the docks. Mr. Lake remained at Hull until March, 1902, when, on the re-organisation of the North Eastern Railway Staff, he was transferred to York. He acted as assistant goods manager in that city until he received his present appointment.

Probably few people will be inclined to deny that Cardiff is amply entitled to the honours which have just been conferred upon her by His Majesty the King. Henceforth she is ranked as a city, and her chief magistrate will be known as the Lord Mayor. When it is considered how much we owe to our native coal supplies, it seems only fitting that Cardiff, which may be considered as the crux of the industry, should have all the privileges to which a city is entitled. Moreover, it is only right that civic honours should be awarded to those who have shown pre-eminently their realisation of civic responsibilities. The present Lord Mayor, Alderman Robert Hughes, Sir E. Reed, Lord Bute, Sir William Thomas Lewis, and the other men who are chiefly identified with the welfare of South Wales, are to be congratulated upon the honours done to Cardiff, whose inhabitants will in future

[illegible] LAKE.

[illegible] manager of the Barry [illegible]

SIR MARCUS SAMUEL, BART., D.L., J.P.

President of the Institute of Marine Engineers, who presided at the society's annual dinner last week.

rank as the "Citizens of no mean City." We remember a mayor who boasted that he had come into the town of his adoption with a bun in one hand and a penny in the other. Alderman Hughes tells us that he had 18d. when as a boy he arrived in Cardiff. His career offers a notable example of patient and successful industry, and he will go down to posterity as a man who preferred the general advancement of Cardiff to the purely personal distinction of a knighthood.

The British Science Guild, which was formally inaugurated at a meeting held at the Mansion House on Monday last, is supported by men whose names have become famous in all branches of learning, and in Mr. Haldane, the President, it possesses a man who has frequently given evidence of his zeal in the cause of technical education. At the first glance it would appear that the new Guild rather overlaps the functions of the British Association, to which, indeed, many of those interested in the British Science Guild belong, but this, it was pointed out at the inauguration meeting, is a mistaken view. The Guild assigns to itself duties which have not been undertaken by any existing body. We are told that its special work will be to convince the people of this country of the necessity for applying scientific methods to all branches of industry; to press upon the Government the scientific aspect of all questions of national concern; to promote the application of science to industrial and general purposes, and to encourage the support of Universities.

This is a truly wide field, and even while one may doubt if the new organisation is not taking upon its young shoulders a burden almost too great for its newly awakened energies, yet its aims will win universal sympathy. If the Guild really makes a serious attempt to grapple with the programme thus outlined, it has opened to it a vast field of usefulness. Everything will depend upon the manner in which the practical side of the work is carried out. We need no fresh organisation to point out the necessity for reform in the directions indicated. Of the need for national efficiency one has heard enough; what has hitherto been lacking is a means whereby this need may be supplied. In some respects, perhaps, the condemnation of existing conditions, made by the sponsors of the new guild, was a little too sweeping. One is glad to note that Sir William Mather protested, and protested quite fairly, against the common charge that in British industry science is a neglected force. This is only partly true. It is well known to those who have taken the trouble to look into this question, that in connection with the workshops of our great industries, there exist research laboratories where the latest discoveries are investigated and pressed into the service of our manufacturers. However, if the new Guild has been established with an undue amount of banging on the big drum, its proceedings will none the less be watched with more than common interest.

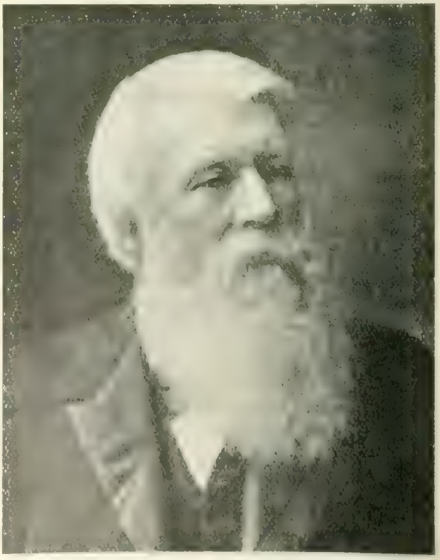
Meteorologists who have not yet satisfied themselves as to the causes of the changes in the weather, should write to Mr. C. Marti, of Nidan, Switzerland, for a copy of a pamphlet which he has re-issued, entitled, "The Weather Forces of the Planetary Atmospheres." In common with other scientists this gentleman, some time ago, gave a good deal of attention to sun spots and their possible influence, but it appears that just when he was feeling most discouraged as to the possibile outcome of his labours a heavy thunderstorm came on, during which he happened to notice that Venus stood in heliocentric conjunction to Jupiter. This set him upon a train of investigation as to the influence of the planets upon our weather, and he finally developed the following hypotheses.

1. Only planets with dense atmospheres appear to exercise an influence on the weather, viz., Mercury, Venus, Jupiter, Saturn, Uranus, however much they may differ in distance and size.

2. The planets are active only in two orders, viz., (1) Mercury with Uranus and Saturn, (2) Venus with Jupiter and a number of the minor planets.

If the author's theories are adopted, the mere weather station man will have to take a back seat, Government astronomers will be busy every day calculating the orbits of the planets, and the conjunctions, rotations, and astronomical perturbations in those orbits. The meteorologist will carefully study the effects of these forces and perturbations, and weather forecasts will cease to be a delusion and a snare. It sounds too good to be true. The author admits that as regards his views on radiation from the planets he is alone in the world, but his pages contain the results of eighteen years labour, and as such they are at least worthy of careful examination. "Investigators," he says, "such as M.M. Becquerel, Giesel and Elster have written to me, that they consider the existence of these planetary rays quite possible. But what I want is not belief, only an examination."

According to a recent return there have been built for the British Navy since 1893 forty-six battleships, twenty-two armoured cruisers, twenty first-class protected cruisers, and seventeen second-class protected cruisers, the total cost of construction being £81,154,268. Of this total of 105 vessels, forty-seven have been built in the Royal dockyards, consisting of twenty-eight battleships, five armoured cruisers, and fourteen protected cruisers. Eighteen battleships, seventeen armoured cruisers and twenty-three protected cruisers have been constructed by private firms.



[illegible] WILSON SWAN, D.Sc., F.R.S.

[illegible] many happy returns [illegible] his seventy-seventh birthday.

New York has received a somewhat severe shock. Their fire-alarm service has been weighed in the balance and found very much wanting. Last December, according to the Electrical World, of New York, a committee appointed by the Board of Fire Underwriters to investigate the fire-alarm service of the Borough of Manhattan and New York City, secured the services of Mr. Kempster B. Miller to conduct a technical investigation of that service, with Mr. J. J. Carty acting as consulting engineer. Mr. Miller's report has now been printed, and his conclusions, following on thorough investigation, are startling. The fire alarm telegraph system of the Borough of Manhattan is reported fundamentally wrong in design. It is not constructed in accordance with any proper engineering plans, and its physical condition is so bad that it must be characterised as being in an advanced stage of decay, and liable at any time to such failures as to render it wholly useless to the fire-fighting department in the time of its greatest need. Faulty in original design and construction, the plant has deteriorated, has been patched and repaired in its various parts as they, from time to time, became unworkable; and it is declared that the system long ago reached the stage where it could not be transformed into permanent proper working order by any further patching or even by radical repairs. As a consequence of this deplorable situation, Mr. Miller considers that the only remedy is to establish a new fire-alarm system, separate and distinct from the present one, and when the new system has been established and is in working order that the old one be abandoned and dismantled.

Mr. Miller recommends a single fireproof central office to be solely used for the purpose, and occupied only by those charged with the duty of operating and maintaining the fire-alarm system. The electrical apparatus within the building should be of a fireproof nature, and mounted upon non-combustible supports, no ornamental cabinet work being used. The number of cable approaches should be made as numerous as practicable in order to avoid danger of total interruption. The report goes into detail concerning feeder cable routes, box circuit arrangement, gong circuit arrangement, box and gong circuit conduit, types of cables and manholes, terminal posts, fire-alarm boxes, box location, signalling instruments at the apparatus houses, central office apparatus, and the telephone system. For fire-alarm cables, rubber-covered, lead-encased wire is recommended, and for telephone circuits the usual paper-covered, lead-encased twisted cable; it is further recommended, however, that the city shall not operate the telephone service between the central office and the various department houses, but lease the necessary facilities from the telephone company doing business in New York. The system of wire circuits recommended is radically different from the present system, and new types of terminal posts and improved form of fire-alarm box are recommended. An entirely new kind of central office apparatus is also recommended. Mr. Miller points out that his recommendations, although in some respects radical, are, as a whole, conservative in view of the existing situation.

The Chairman of the International Board of Consulting Engineers intrusted with an examination of the Panama proposals reports that there are now 13,000 men employed in all branches. Two thousand three hundred men are at work unloading and distributing material; 2,600 repairing and constructing buildings, and 2,600 in the Culebra cut, where already there are 16 steam shovels at work, trying to get the face of the cut in shape so that, as soon as the type of canal is decided upon, it will be possible to get right down to the solid digging. In addition to this, men are at work putting in railroad yards, wharves, and docks at both ends of the lines.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

DAVIDGE PAGE, Editor.

Clun House, Surrey Street, Strand, London, W.C.

Telephone No: 3349 GERRARD.
Telegraphic and Cable Address: "SINEWY, LONDON."

Correspondence *is invited from any person upon subjects of interest to the engineering community. In all cases this must be accompanied by full name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

The Editor does not hold himself responsible for the opinions expressed by individual contributors, nor does he necessarily identify himself with their views.

Subscription Rates per Year.

Post free to any part of the world—In advance, 20s. for twelve months.

Sample Copies: United Kingdom, 6d., post free; Abroad, 8½d. post free.

Remittances should be made payable to PAGE'S WEEKLY and may be forwarded by Cheque, Money Order, Draft, Post Office Orders or Registered Letter. Cheques should be crossed "LONDON & COUNTY BANK, Covent Garden Branch." P.O.'s and P.O.O.'s to be made payable at East Strand Post Office, London, W.C. When a change of address is notified, both the new and old addresses should be given. All orders must be accompanied by remittance, and no subscription will be continued after expiration unless by special arrangement. Subscribers are requested to give information of any irregularity in receiving the Weekly.

When Foreign Subscriptions are sent by Post Office Orders advice should be sent to the Publisher.

Foreign and Colonial Subscribers receiving incomplete copies through newsagents, are requested to communicate the fact to the Publisher, together with the agent's name and address.

New Copy for Advertisements,

Alterations, &c., intended for insertion in the current week's issue must be delivered **not later than 4 p.m. on Monday.** If proofs are required the copy and blocks should reach us several days earlier.

MEETINGS, ETC., FOR THE ENSUING WEEK.

FRIDAY, NOV. 3.—Junior Institution of Engineers: Presidential address, Mr. Dugald Clerk, "Problem of the Gas Turbine," 8 p.m.

SATURDAY, NOV. 4.—Birmingham Electric Club: Paper, "[illegible] Furnaces," by Mr. J. H. Stansbie," 7.30 p.m.

MONDAY, NOV. 6.—Institute of Marine Engineers, [illegible] Stratford: "Photo Enlarging," by Mr. H. [illegible] Society of Engineers: Royal United Service Institution [illegible] "Metallic Preservation and Ornamentation of Iron [illegible]" Mr. Sherard Cowper-Coles, 7.30 p.m.

TUESDAY, NOV. 7.—Institution of Civil Engineers: Presidential address by Sir Alexander Binnie, 8 p.m.

WEDNESDAY, NOV. 8.—Geological Society of London.

THURSDAY, NOV. 9.—Institution of Electrical Engineers: Presidential address by Mr. John Gavey, C.B., 8 p.m.

NEWS ITEMS.

In the latest type of submarines the ventilators are fitted with quick-closing valves which will render impossible a repetition of the A4 accident.

It is stated that Sir William Garstin, G.C.M.G., is about to receive from the Egyptian Government a cheque for £15,000 in recognition of his services as Adviser for Public Works.

On Tuesday congratulations from all parts of the world reached Sir Joseph Wilson Swan, D.Sc., F.R.S., on his birthday. Sir Joseph entered his 78th year, but is still a comparatively young man for his age.

We understand that the tender of Messrs W. Sandford, Ltd., of Nithgow, has been definitely accepted for the supply of all the pig-iron required by the N.S.W. Government during the next seven years. Details of the tender were given in our last issue.

It is announced that the Pratt and Whitney Company have purchased a plant in Dundas, Ontario, for the manufacture of their full line of small tools, taps, reamers, milling cutters, punches, dies, etc., etc. The building is a modern structure, and the power plant is already in place. The machinery is being equipped at Hartford. The plant, we are informed, will also include a department for manufacturing a full line of twist drills, an elaborate equipment of special machinery having been designed for the purpose. The location of the factory is near that of the John Bertram and Sons' Company, recently purchased by the Niles-Bement-Pond Company.

CONTENTS.

THE S.Y. BRANWEN.

The first steam yacht launched from the Woolston Works of Messrs. John I. Thornycroft and Co., Ltd.

Leeds Association of Engineers.

At a meeting of the Leeds Association of Engineers, held on October 25th, a lecture was delivered by Mr. Percy Rosling on "The Economics of Electric Driving."

He treated the subject from a commercial standpoint, and named the following points as necessary to be taken into account in determining whether to drive direct from an engine or electrically.

The size of the plant and the arrangement of the drive, especially with a view to the reduction of frictional and other losses.

The relative out-of-pocket running costs.

The advantages of a sub-divided drive.

The extra output through the greater speed of electrically-driven plant, with facility for checking the actual time of tools being in work.

In comparing the methods of obtaining current for the electrical drive, points in favour of a central station supply were: Freedom from trouble in providing power for the works; the use of a larger amount of the capital on money-earning tools, thus increasing the capacity of the works; the ability to run the whole of the works short hours in slack times; and the possibility of running a portion of the works overtime or double shift economically.

It was shown that in actual practice a gain of from 4 to 10 per cent. had been effected in output by the use of induction motors, owing to their regularity of speed and the elimination of slip in main and intermediate belts.

With regard to capital charges, Mr. Rosling said that where the annual costs of production other than wages and material were in the neighbourhood of 30 per cent. of the capital employed, the money spent on generating plant ought to be debited with 50 per cent. of its cost, per annum, to bring it into line with the rest of the capital, otherwise the money spent on generating plant could be more profitably employed on productive machinery. He thinks that in no case, in a money-making concern should the generating plant be debited with less than 17½ to 20 per cent. per annum.

A Naval Exhibition Award.

In connection with the Naval Shipping and Fisheries Exhibition, Earl's Court, the Stirling Boiler Company, Ltd., have been awarded a diploma and gold medal for their exhibit, which included a marine Stirling boiler, of 280 h.p. Part of the casing was removed to show the arrangement of the drums and tubes in the boiler. A special feature in the boiler was that it was lined with diatomite brick. The brick caused considerable interest in that it has a great advantage over ordinary firebrick, being a much more efficient non-conductor, and at the same time only one-seventh of the weight. The various tube cleaners used for cleaning the tubes of these boilers were also on exhibition. One of the tubes was split from end to end, and a turbine cleaner inserted, thus showing how this efficient cleaner is worked.

G.W.R. Locomotive Department

During the four weeks ended October 14th, six new engines were turned out, viz., No. 190 (the last of the ten *Atlantics*), Nos. [illegible] 3, 4, and 5—*Consolidation* type, and No. 2221, a heavy side-tank engine; four-wheels coupled; 6 ft. 8½ in. diameter; outside cylinders, 18 in. by 30 in. Ten of the latter are to be constructed, and are intended for heavy express passenger traffic.

In the case of one of this type it appears that a radical departure has been made from G.W. standard practice, the engine and tender having been painted black, lined out with red. The effect certainly is striking, and, adds "A.J.L.W.," in the G.W.R. Magazine, it will be interesting to observe the qualities of the paint under severe working conditions.

Miniature Locomotives.

We illustrate on this page a locomotive of the type manufactured by the Miniature Railways of Great Britain, Limited. The engine has been in actual service on the Blackpool track, and is a very powerful miniature locomotive. A recent "Atlantic" type of express locomotive was chosen as a model, and all the best features of that design have been reproduced. The "Little Giant," as the miniature is named, is exactly one-quarter full size of a real locomotive, and measures 14 ft. $1\frac{1}{4}$ in. over the buffers. The cylinders are $3\frac{1}{2}$ in. bore, and have a stroke of 6 in. The driving wheels are 18 in. diameter, and the firebox is of ample dimensions. The engine weighs, in working order, 2,400 lb., and the tender 850 lb. The latter carries 35 gallons of water, and 56 lb. of coal. The model will develop 8 h.p. The work of construction from the time of commencing on the first castings and forgings to the last coat of paint, occupied just twenty-two weeks.

At the speed test, made on the private line of the Duke of Westminster at Eaton Hall, the locomotive attained an average rate of $22\frac{1}{4}$ miles per hour, for over one mile, the load behind the tender being $2\frac{1}{2}$ tons. For half a mile the average was $26\frac{1}{2}$ miles per hour. Mr. Henry Greenly is responsible for the design.

Parsons' Turbine Company.

The report of the Parsons' Marine Steam Turbine Company contains some interesting information and throws a sidelight on the growing use of the turbine for marine propulsion. The company have at present eight sets under construction at their works, and twenty-eight sets are being manufactured by other engineering companies at the present time under licence. The company has purchased the land on which the works are situated at Wallsend, and arrangements are being made for the acquisition of plant to cope with the manufacture of larger sizes of turbines than the company has hitherto been able to deal with, this addition having become necessary in consequence of the application of the turbine system to the largest mercantile vessels and warships.

The Simplon Tunnel.

It had been expected that the Simplon tunnel would be opened on January 1st, but the Temps announces on official authority that the line will not be ready before May 1st. Hopes are entertained that this delay will enable electric traction to be employed from the first, a plan which temporarily had been abandoned, but which the Italian Government is understood to be desirous of seeing realised.

Returns just issued show that on railways in the United Kingdom in the course of public traffic 241 persons were killed and 1,323 were injured, during the three months ended June 30th, 1905, as compared with totals of 230 and 1,425 respectively for the corresponding period in 1904.

"LITTLE GIANT" MINIATURE LOCOMOTIVE.

Electric Power for London.

The Highways Committee of the London County Council have issued a report directing attention to the important issues raised in connection with the Electric Power Bills which were brought before Parliament last session. It will be remembered that the most important of these schemes, that of the Administrative County of London and District Electric Power Company, contemplated the supply of energy over an area of upwards of 500 square miles. The right of purchase by the borough councils, which is a cardinal feature of the Electric Lighting Acts of 1882 and 1888, still exists, but its value and practicability have become seriously jeopardised by the character which companies' undertakings have assumed. Inasmuch as a single company's undertaking often extends through several boroughs, whilst there is only one generating station, many local authorities will, if present circumstances continue, only be able to buy mains and no station, while others will only be able to buy mains and a station far too large for the needs of a single borough. In some cases, moreover, the stations in isolated areas of supply, and, it is contended, not purchasable at all. The scheme of the Administrative Company, however, raises these issues in a far more acute form, and a conference on the whole subject has been called, and is to be held this month.

DUGALD CLERK, M.INST.C.E., F.C.S.

Who delivers his presidential address before the Junior Institution of Engineers to-night.

Policy of the L.C.C.

There is a natural objection on the part of the Council to see a huge private monopoly set up in the area under its control, and there is a feeling that the work can be done by the properly constituted authorities. The committee have not at present gone fully into the details of a definite scheme for the supply of electrical energy; but, from reports which they have had before them, and having regard to the favourable position in which the Council stands in many respects, they are of opinion that it will be quite practicable to put forward a satisfactory scheme. The importance of providing cheap electrical energy for general use in London is not being overlooked, nor the desirability of securing continuity of the policy of public control, which was intended to be ensured by the purchase clauses of the Electric Lighting Acts of 1882 and 1888.

Shipbuilding in Scotland.

The summary figures of Scottish shipbuilding for October bear testimony to the revival of the industry. In the matter of output the month has produced 42 vessels of 64,211 tons. This makes a ten months' total of 287 vessels of 457,493 tons, which is 11,224 tons higher than that of 1902, which held the former record at the corresponding period. In the matter of contracts, too, the end of the month shows figures which are even more noteworthy. Altogether there were reported orders for 47 vessels of over 100,000 tons gross. This makes the total for Scotland since the beginning of the year [illegible] tons, that is much more than the average work of a whole year.

The Month's Launches.

The October launches, distribution over the different districts of Scotland, and also the figures for previous months this year, are shown in the following table:—

	CLYDE.		FORTH.		TAY.		DEE.	
	Ves.	Tons.	Ves.	Tons.	Ves.	Tons.	Ves.	Tons.
Jan. ..	8	20,202	1	[illegible]	1	400	1	135
Feb. ..	12	42,499	2	[illegible]	1	4,300	—	—
Mar. ..	[illegible]	[illegible]	1	[illegible]	2	2,330	3	[illegible]
April ..	25	35,665	[illegible]	4,840	1	520	4	[illegible]
May ..	[illegible]	[illegible]	2	[illegible]	4	340	1	175
June ..	22	39,620	[illegible]	1,220	3	6,200	2	[illegible]
July ..	[illegible]	[illegible]	1	75	—	—	4	743
Aug. ..	[illegible]	[illegible]	4	[illegible]	1	2,300	2	502
Sept. ..	[illegible]	[illegible]	—	—	1	680	5	[illegible]
Oct. ..	[illegible]	[illegible]	3	[illegible]	7	4,370	4	825
	[illegible]	[illegible]	22	[illegible]	21	[illegible]	[illegible]	7,270

TECHNICAL SOCIETY NOTES.

The Institution of Civil Engineers will commence its eighty-seventh session on November 7th, when the president, Sir Alexander R. Binnie, will deliver his inaugural address. Among the subjects which will be brought forward in papers during the session for instruction and discussion will be "Waterways in Great Britain," "The Widnes and Runcorn Transporter Bridge," "The Steam Turbine," "Heat Economy in Factories," "The Railway Gauges of India," "The Outer Barrier, Hodbarrow Mines," and "The Heysham Harbour Works."

The paper on "Cornish Tin Mining Methods," read by Mr. Dietzsch, before the Institution of Mining and Metallurgy, with its direct challenge to Cornish mining men, has had the effect of a bombshell in the camp. Mr. Dietzsch has hit hard, and those whom he decries as the apostles of an alleged effete school are not likely to sit still under his somewhat caustic criticism. On the whole it would seem that Mr. Dietzsch's visit to Burma has been exceedingly well-timed. An authoritative reply to his indictment is likely to be forthcoming in the near future, and the controversy which has been evoked cannot fail to be productive of good. Facts will doubtless be forthcoming as regards the much dicussed questions of classification and dressing losses which should be calculated to throw much light upon the respective merits of different methods, and generally tend to solve much that is at present more or less in the air. The Institution under whose auspices the paper was read may be congratulated on having opened up to discussion a subject of national importance.

Professor Goodman presided over the opening meeting of the Leeds University Engineering Society when a paper, "Induced Draughts for Steam Boilers," was read by Mr. W. H. Casmey. The author contended that in induced draught lies to a large extent the remedy for the loss and annoyance caused by the smoke nuisance. He proceeded to show theoretically that this method is an improvement on natural draught or forced draught by means of steam jets. He claimed the advantages of smaller coal consumption, increased boiler capacity, and positively decreased cost, giving figures and diagrams obtained from actual experience in support of his statements.

On Wednesday evening was held the opening meeting of the Liverpool Engineering Society, when Mr. J. Reney Smith, M.I.Mech.E., M.I.N.A., delivered his presidential address. The programme for the session includes papers on "Processes for Rendering Iron and Steel Non-corrosive," "The Sa vage of Ships," "The Use of Electric Power in Collieries," "Some Economic Aspects of Electric Power Supply," "Transatlantic Lines and Steamships," "The Progress made in the application of the Parsons' Turbine to Marine Propulsion," "Motor Vehicles in 1905, for Pleasure and Commercial Purposes," "Electrical Testing," and "Sewerage and Sewage Disposal."

The inaugural address of the president of the Manchester Association of Engineers was delivered on Saturday last. Mr. R. Matthews gave an interesting retrospect of the changes and improvements in the branches of engineering in which the members of the association were interested. He pointed out that in steam boilers the "Lancashire" still held its own for simplicity and economy, and that steam engines generally had little altered during the past fifty years, the greatest improvements having been in economy, principally due to compounding. The marine engine was threatened with displacement by the turbine; gas and oil engines promised to become one of the new sources of power. But perhaps more mechanical improvements had been made in military engineering than in any other sphere, while spinning and weaving machinery appeared to have reached the limit of maximum speed with minimum of cost. Mr. Matthews also discussed the fiscal question in its relation to engineering, and incidentally accused the press of decrying British work, and bestowing undue praise on American productions. This is rather a sweeping statement, and can only apply to the lay press; certainly not to the technical journals, and least of all to Page's Weekly.

A paper on "Roller Bearings" was read by Mr. T. W. How, F.R.G.S., before the Tramways and Light Railways Association, on Wednesday last, at the Society of Arts. Mr. A. L. C. Fell, M.I.E.E., the chief officer of the London County Council tramways, is to give the long-deferred paper on "Brakes" before a meeting of the Association to be held at the Institution of Civil Engineers on January 10th next. Reference was made in our issue of September 22nd to the exhaustive brake trials being carried out by Mr. Fell, and the results to be presented in this paper are sure to excite widespread interest. The programme [illegible] lectures on "The Upkeep [illegible] Motor[illegible]" by Mr. S. [illegible]udworth and on "The Thermit System of Electric Welding," by [illegible].

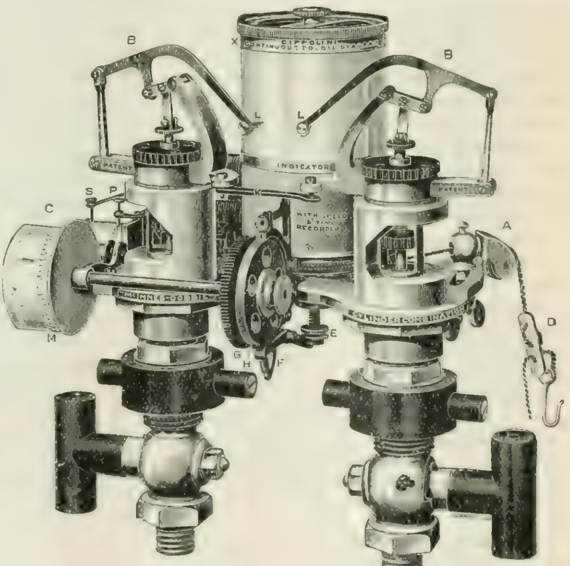
A CONTINUOUS DOUBLE DIAGRAM INDICATOR.

WE have pleasure in calling attention to an ingenious form of indicator which is being introduced by Dobbie, McInnes, Ltd., of Glasgow. It is known as the Cipollina Continuous Double Diagram Indicator, and seems likely to play an important part in connection with locomotives, torpedo boats, and all engines where it is difficult to indicate in the ordinary way; also for recording steam trials.

The apparatus, as will be seen by the accompanying illustration, consists of two indicator cylinders, with pistons and parallel motions of the "M'Innes-Dobbie" patent type, the pressure springs being exterior to the steam cylinder and rendering the indicator particularly accurate at high pressures. The cylinder caps, coupling nuts, and other parts are sheathed with a special vulcanite preparation to prevent burning of the fingers. Pressure springs are fitted exactly as in an ordinary indicator.

Both pencil arms point towards the same paper cylinder, this latter containing a roll of metallic paper. One of the indicator cylinders is attached to the top of the engine cylinder and the other to the bottom. The cocks can either be placed between the indicator and the piping, or at the end of the piping against the engine cylinder.

The cord lead D, adjustable to any angle, is next attached to a suitable part of the engine. Assuming now the engine to be in motion, when the cocks are opened, and the drum cord connected to the engine, the pencil arms rise and fall and the drum reciprocates at each stroke. But this indicator is not intended to take diagrams at every revolution. At every stroke of the drum, by means of internal mechanism, the spindle E is lifted upwards, imparting motion to the cam F, which propels the ratchet wheel G one tooth forward for every revolution. Attached to the wheel G there is a cam wheel H having a plain surface with projecting points on it. Both wheels turn round together, the pawl I resting on H, and when a projection comes under it, the pawl I is of course raised. This pawl in turn, by means of connecting bracket K, carries the two pencil points L against the metallic paper. As the paper drum is reciprocating, and the pencil arms rise and fall at each stroke at this moment of contact, one pencil gives a diagram from the top end of the cylinder and the other a diagram from the bottom end, both being taken simultaneously and on the same length of paper. Until this moment of contact the metallic paper has been reciprocating with the drum, but immediately the diagrams are taken the pencil points are released and the same mechanism now causes the length of paper occupied by the diagrams



CONTINUOUS DOUBLE DIAGRAM INDICATOR.

[illegible] taken to be drawn forward onto the [illegible] the spindle leaving a fresh portion of the [illegible] paper drawn from the other spindle ready for the next set of diagrams. This goes on automatically until the paper is exhausted.

The cam H determines the diagram intervals. That shown in the illustration has two projections causing diagrams to be taken at every 50 revolutions, but each indicator is supplied in addition with interval wheels to give diagrams at every 25 and 100 revolutions. On the indicator shown, with the engine running at 100 revolutions, double diagrams would be taken automatically at every half-minute. These diagrams being complete in themselves can be accurately computed and compared.

The indicator can be used with or without the special revolution and time indicator shown. The roll of paper on which the power diagrams are traced can be arranged in conjunction with the strip showing revolutions and time, thus giving a clear indication, and showing in a manner that cannot be contested two essential elements required for an accurate engine trial. Those elements are the moment at which the diagrams were taken in connection with the number of revolutions, and the number of revolutions that the engine was making at the moment when the observation was taken.

The chief advantages claimed for the indicator are stated as follows: The true power of the engine, because all the elements necessary to the calculation are registered simultaneously; continuous successive variations in power and of the moments at which they occur as the diagrams are repeated automatically at specified intervals; the instrument being automatic in action the diagrams are beyond the influence of the parties interested and cannot be tampered with; the indicator may be applied to any engine and in any position without the need for cumbrous attachments; it works with little or no attention, the feed of the paper rolls, for pressure, revolution and time diagrams, being automatic, as also the moment of contact of the pencil points, so long as the cord lead is attached and the engine in motion.

OBITUARY NOTICE.

Mr. George Robert Stephenson, a nephew of George Stephenson, died at Cheltenham last week at the advanced age of 87. He was for many years at the head of the engineering works established by the Stephenson family at Newcastle. He had been connected with railway engineering from his earliest days, having joined the engineering staff of the Manchester and Leeds Railway as long ago as the year 1837. At a later date he superintended construction work on the South Eastern Railway, and was afterwards engineer-in-chief to many home railway undertakings. He was also associated with the Danish Government Railways. Subsequently he went out to New Zealand as consulting engineer to the province of Canterbury, and constructed some of the first railways built in that Colony. He was the President of the Institution of Civil Engineers in the years 1876 and 1877, and at the time of his death was the senior past-president of that body.

Mr. Joseph Gamble was probably the oldest of the Sheffield steelmakers. He was a native of the city, and served his apprenticeship in one of its shops. Since 1871 his firm have been associated with the Wadsley Bridge Steel Works, which, from small beginnings, has become one of the principal steel concerns in Sheffield. He was also a director of John Round and Son, Ltd., Davey Bros., Ltd., and Ibbotson Bros. and Co., Ltd.

The death is announced of Mr. William Henry Lewis, of Cardiff. Mr. Lewis was one of the principal coal owners of South Wales, and was managing partner in the firm of Messrs. George Insole and Son. He was an ex-president of the Cardiff Chamber of Commerce, chairman of the South Wales and Monmouthshire Coal Freighters' Association, a member of the Coalowners' Association, a director of the Employers' Mutual Indemnity Society, and on the executive committee of the Mining Association of Great Britain.

[illegible] Fry.

THE LATE GEORGE ROBERT STEPHENSON.

ALTERNATE CURRENT INDUCTION MOTORS.

By T. Harding Churton.

I PROPOSE to compare the performance and characteristics of motors of the induction type when provided with short circuit and with wound rotors respectively; to compare the performances of such motors on single-phase and polyphase circuits respectively; and to indicate, by comparisons, the extent to which the working of such motors is affected by the frequency of alternations.

For the purpose of illustrating the above comparisons, the performance of a particular size of machine with short circuit and with wound rotor, for single-phase and for polyphase working, and on circuits of various periodicities, will be taken, the particulars given being the results obtained from actual tests on a number of machines of the same size. The windings were, in each case, appropriate, of course, to the circuit upon which the motor was to operate. It is not suggested that the comparative results here shown necessarily apply in all cases, but they may at least be taken as fairly representative.

In the case of two-phase or three-phase motors a considerable starting torque may be obtained with short-circuit rotors having conductors of comparatively high resistance. But such resistance seriously affects the efficiency, as well as the slip, of the motor when running on load, and motors so constructed are usually employed therefore only for intermittent work, such as, for example, operating cranes. When an induction motor is required to combine relatively high starting torque and high efficiency on load it should have a wound rotor and variable starting resistance. If, however, so high a starting torque is not required, the short-circuit rotor with low resistance conductor is preferred on account of mechanical superiority, greater electrical efficiency and overload capacity.

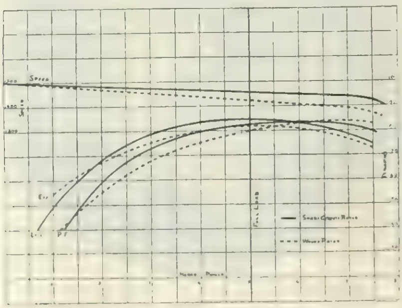


FIG. 1.—CURVES FROM SHORT CIRCUIT AND WOUND ROTOR.

EFFICIENCY AND POWER FACTOR.

The curves shown in fig. 1 are from tests taken upon two motors, one having a short-circuit rotor and the other a wound rotor, but which were in other respects identical machines. It will be noticed that both the efficiency and power factor are higher in the case of the machine with the short-circuit rotor. Both machines were constructed to give 5 brake horse-power at about 1,420 revolutions on single-phase, 200 volt, 50-cycle circuit. The starting torque obtained with the short-circuit rotor machine was ·45 full-load torque with 1·25 times full-load current, while the wound rotor machine gave ·75 full-load torque with full-load current. The slip is somewhat greater with the wound rotor, which would, moreover, pull out of step rather sooner than the short-circuit rotor. The difference between the results obtained with the short-circuit and wound rotors on polyphase working is practically the same as that on single-phase, though with the polyphase system the results themselves are much better, as will be shown later.

Speed regulation has been so far, perhaps, the least satisfactory feature of the induction motor.

For the purpose of speed regulation, the wound-rotor motor is the more satisfactory, though for some purposes, such as operating cranes, the short-circuit rotor with conductors of relatively high resistance, combined with graduated transformers, for varying the voltage on the stator windings, is sometimes preferred for polyphase motors.

SINGLE-PHASE AND POLYPHASE WORKING.

To compare now the performance of the motor on single-phase and on polyphase working, it must be remembered that the field produced in the single-phase motor is not a uniformly rotating field as it is in the case of a polyphase motor. When the rotor is at rest, a simple alternating-current in the stator winding would produce only an oscillating field which would not cause the rotor to move at all. To start up

the motor, therefore, a second winding is placed at 90 deg. to the main winding, and by causing the current to lag in one winding and giving a lead to the current in the other winding, a phase difference is produced which creates a rotating field. But whereas the currents in a regular two-phase stator differ in phase by 90 deg., those in the single-phase motor cannot be made in the above manner to differ by anything like so much, and the resulting field is, in consequence, very irregular. As the rotor gains speed, the field due to the combined action of the stator and rotor currents becomes more uniformly rotating, but never attains to the uniformity of the field produced by polyphase currents. For the above reason, motors of this type have not nearly so good a starting torque on single-phase as on polyphase circuits. And, for the same reason, the maximum running torque and brake horse-power of the motor is less when working single-phase than polyphase, and the single-phase motor will, moreover, pull out of step and stop with less overload than the polyphase motor will carry.

TABLE I.

	Single-phase		Polyphase	
	Starting Current	Starting Torque	Starting Current	Starting Torque
Short-circuit rotor ..	1·25	·45	1·25	[illegible]
Wound rotor..	1	·75	1	1

NOTE.—The figures refer to the normal full load values.

SUPERIORITY OF POLYPHASE MOTOR.

Table 1 shows the performance of the motor with regard to starting torque and current on single and two-phase circuits of 50 cycles, 200 volts, and with short circuit and wound rotors respectively. The superiority of the polyphase motor in this respect is clearly shown.

The curves in fig. 2 show also that the efficiency and power factor are higher in the case of the polyphase motor and that the slip is greater in the single-phase motor.

The lower efficiency of the single-phase motor is accounted for by the greater iron losses due to the irregular flux, and to the torque being lower on account of the irregularity of the field. And the power factor is also lower because the greater slip of the rotor retards the rotor field which consequently becomes more out of phase with and thus opposes the stator ... leakage co-efficient and self-induction of the stator winding are thus increased, and the power factor is therefore reduced.

STARTING METHODS AND PHASE DIFFERENCE.

A great deal of attention has been paid to the methods of starting the single-phase motor, the principal object being generally to obtain as great a phase difference as possible between the currents in the main and starting coils.

There are several means by which the starting torque of the single-phase motor may be somewhat improved, but which involve lower efficiency on load. And, as in most other problems in engineering, the question as to how far the running efficiency shall be sacrificed to improved starting performance is a matter of compromise.

The results actually obtained depend, of course, upon the details of design, particularly with regard to the flux-densities, shape of the stator and rotor teeth and length of air gap, as well as upon the materials employed, particularly the quality of the iron in the stator.

While the single-phase motor cannot upon equal terms compete with the polyphase motor, it is, nevertheless, in its better forms, an excellent machine.

The question of frequency is a very important matter with regard to induction motors. In the first place, the torque exerted by the motor is inversely proportional to the frequency of the supply current, and a given size of motor will therefore be capable of giving twice the horse power on, say, 50 cycles that it can give at the same speed on 100 cycles. In order, therefore, that the motor may give the same maximum horse-power on 100 cycles as on 50 cycles, the speed must be doubled. The loss due to hysteresis is directly proportional to the frequency. If, therefore, the frequency is greatly increased, the induction—and

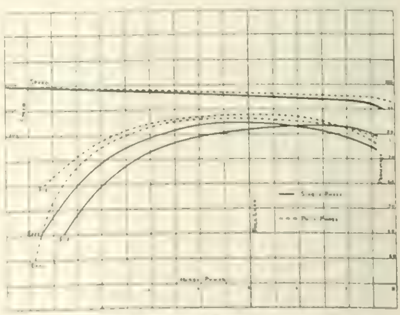


FIG. 2.—CURVES OF EFFICIENCY AND POWER FACTOR.

therefore the torque must be much reduced to prevent heating of the iron, and noise. But the magnetisation curve not being straight, the watts spent in magnetising are not diminished in the same ratio as the induction is reduced. Thus the iron loss is greater at the higher frequency, and other things being equal the efficiency of the motor is, therefore, lower.

And the leakage co-efficient being greater at the higher frequency, the power factor is, therefore, lower. This again, by increasing the currents, increases the C^2R losses which therefore further reduces the efficiency.

HYSTERESIS LOSS ON HIGH FREQUENCIES.

The hysteresis loss and leakage co-efficient increase much more rapidly on the higher range of frequencies than on the lower. For example, the difference is much greater between 50 cycles and 100 cycles than between 25 and 50 cyles.

The curves in fig. 3 show the difference in the efficiency, power factor, and slip of the same size of motor as before referred to when giving 5 brake horse-power on 50 cycles at about 1,430 revolutions per minute, and the same horse-power on 100 cycles at 1,880 revolutions per minute. It will be here observed that the speed on 100 cycles is not, for the same horse-power, double that on 50 cycles as would have been expected from the statement above. But it may be explained that this was due merely to the exigencies of manufacture, the same standard stampings having been utilised in each case and the windings varied to obtain the required output with the best results. While this arrangement occasionally necessitates the use of a machine somewhat larger than actually required, economies in manufacture are effected which repay the extra cost of material involved.

High frequency is not only prejudicial to efficiency, power factor, and torque, but is particularly detrimental to good starting performance. This will be seen from Table 2, which gives the starting torque and current of the 5-h.p. motor on 50 cycles and 100 cycles respectively.

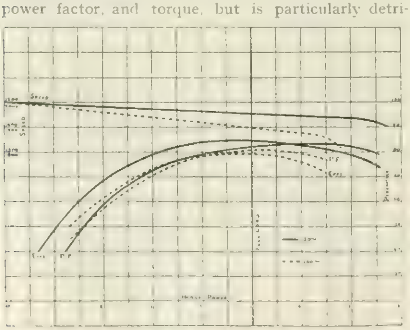


Fig. 3. Curves showing effect of varying cycles and revolutions.

It may be remarked that on circuits of 100 cycles, about twice the full-load current is usually taken for starting short-circuited rotor motors, whereas on 50 cycles the starting current does not usually much exceed the normal full-load current.

TABLE 2.

Starting Torque and Current on 50 cycles and 100 cycles of 5-h.p. motor (short-circuit rotor) 200volts.

Cycles.	Starting Current.	Starting Torque.	R.P.M.
50	[illegible]	·45	[illegible]
100	2	·43	[illegible]

High periodicity to the motor user implies higher cost of motors, and higher cost of working, and to the electricity supply undertaking it means lower day load (because of the less inducements to power users to adopt the supply), and greater proportional loss on mains, etc., on account of lower power factor of motors.

Most of the systems having frequencies above 50 or 60 cycles were established before induction motors were practically thought of. Some of these are, happily, being gradually changed over to 50 or 60 cycles, and it would be well if a frequency of 50 cycles were adopted whenever possible. Standardisation in such matters greatly promotes economy and excellence in manufacture and promptitude of delivery.

THE REPULSION MOTOR.

The efficiency and power factor of the repulsion motor are not quite so high as those of the induction motor, the current taken for the same horse-power, and on the same voltage and periodicity, being about 60 per cent. higher. And the horse-power of the motor is roughly 70 per cent. of that which it would be as a single-phase induction machine.

The tendency to spark as the short-circuited coils leave the brushes has been a serious difficulty with the repulsion motor. However, if the reactance voltage is kept sufficiently low, and the machine provided with slip-rings—so that the circuits are not really broken—the difficulty of sparking may be quite overcome. The prevention of sparking may, indeed, become more difficult in machines of large size, but with regard to that the writer has not sufficient data to give particulars.

(Abstract of paper read before the Institution of Electrical Engineers (Leeds Local Section).

THE EDUCATION OF MINING ENGINEERS.

By J. B. Porter, Professor of Engineering at McGill University.

ENGINEERS, or specifically, mining engineers, have played a great part in the development of the world's resources; but the work is only begun. If the signs of the times are true, we may safely say that the engineering age has just fairly begun, and that the developments of the future, especially in the beneficent use of natural resources, will inconceivably surpass anything we now know.

In view of this, it is our plain duty to see that the young men who are to be the engineers of the next generation shall be as fit as possible for their great task. In technical education mining and metallurgy have always been considered something apart, and often were the first subjects to receive special consideration. In other cases, schools originally instituted as schools of mines crystallised out successively departments of civil, mechanical, electrical engineering, etc.

DANGERS OF SPECIALISATION.

This process of differentiation has gone further in the United States than elsewhere, and no less than twelve separate engineering courses are offered, with more promised for the immediate future. Even in Canada, where we are accused of being conservative, my own university offers its bewildered matriculants six or seven formal engineering courses, and some of these are again branched in the final year. These special courses are no doubt necessary, and their number will probably increase; but great harm will be done to engineering in a broad sense if this tendency to specialised teaching cannot be kept within strict bounds.

The same fundamental sciences underlie all branches; the same training in physics, mathematics, and mechanics is essential to a true understanding of each profession, and the man who learns these and other fundamental subjects thoroughly, even at the expense of technical training, is far more likely to succeed ultimately in any special work than the man who has received elaborate training in one line, but whose first principles are "weak."

An engineering student, whatever his branch, should undoubtedly do some shop work on the ordinary materials of construction at a very early period in his course. He will not be able to spare time enough to become a skilled workman, or even a half-skilled apprentice, and he must be made to fully understand this; but he can and should work long enough to know something of the use of tools, and to understand the qualities of the materials of construction which he is about to study theoretically. This elementary shop work is often attempted in workshops connected with the technical schools themselves, and frequently the work can be done in the afternoons while regular studies are going on. This method is economical of time, and there are many advantages in having the teaching and shop work under the same direction; but in many cases it is better for the boys to get their experience in ordinary shops, where they should be required to work full time under ordinary shop discipline. In no other way can they be made to realise what work really is; intimate acquaintance with workmen is also very useful.

This shop work can usually be arranged for the long vacation, which should be long enough to give time for it, and for a reasonable holiday. Two periods of two or three months each should suffice for an ordinary boy, especially as practical technical training is also required at a later period in his course.

RELATIVE IMPORTANCE OF SHOP-WORK.

[illegible] technical work is even more important, in my opinion, than the shop experience. It should, if possible, follow the general science teaching, and precede the specialisation. Whenever practicable the student should obtain *bona fide* employment in some works in his chosen speciality, but the exact nature of the work is of no very great moment, so long as it is good engineering work, done by good workmen intelligently directed. The important thing is, again, to get the student in touch with real work and real wage-earners, and to give him an idea of scale. The elementary shop work may be done, if necessary, at convenient times in a school workshop; but this technical work must be real in every respect. The student should, for the time being, become [illegible] workman on wages responsible to his foreman for certain duties, and liable to penalty or discharge for cause.

[illegible] The [illegible] forgetful of [illegible] begun [illegible] advanced work [illegible] The teaching may now be distinctly specialised and quite technical, but care must [illegible] principles in sight, and the detailed technical work should be carefully laid out to cover only certain important typical [illegible] be made much more interesting and effective by the free use of [illegible]

(and, where necessary ore-dressing and metallurgical apparatus) can be used; but here, as in the lecture-room, care must be taken to teach principles, not processes. Certain processes must of course, be used, and a good deal of careful detailed work done; but the primary purpose must always be to teach general principles, and mere technology must be kept in a secondary place. The best function of laboratories, aside from the limited use necessary to illustrate fundamental principles, is to develop the individuality of the students. Each man should be given certain carefully selected pieces of independent work, and he should be encouraged to attack the task in his own way.

THE VALUE OF INDEPENDENT WORK

One or two comparatively heavy investigations are far better than many short experiments, and the instructor in charge can often do his men far more good by showing interest, and yet letting them work out their own salvation wherever possible, than by being too ready to set up apparatus and smooth over difficulties. This advanced individual work can utilise to the full the resources of even the most magnificently equipped laboratories; but care should always be taken, especially in schools which, like my own, are very rich in practical apparatus, that the students should do a few things thoughtfully, and with a clear apprehension of their bearing, rather than that they should get shallower experience of many machines and processes.

In the end the men should be taught to write up their work, and to apply the knowledge gained in works, laboratories, and lecture-rooms to some practical problems in engineering. In this, questions of estimates and costs should be considered, for the men are about to go out into the world, where costs form an essential element in every enterprise. Estimates made even by advanced students are likely to be far from right; but their preparation gives the men extremely valuable experience, and a competent instructor can do excellent work by discussing these economical matters with his men in this stage of their work.

The course that I have outlined is, I think, decidedly better than anything that is now offered by the schools at home or abroad, because it makes a certain amount of practical work obligatory, and yet connects, and even combines, this work with at least as much theoretical and pure science work as is now required. It has, however, the disdavantage of taking five years, instead of three or four, and it presupposes the most cordial support of works and mine managers.

* Abstract of lecture delivered at Kimberley before the British Association.

CATALOGUE COVER DESIGN.

The design reproduced herewith is used by the Electrical Company, Ltd., for the embossed cover of their catalogue of Nernst Lamps. Among other things claimed for these lamps is that their colour more nearly

approaches sunlight than does that of any other artificial illuminant—an inestimable advantage for lighting places in which colours have to be judged. This fact seems to have been seized upon by the artist, who has rendered the lamp in yellow. By a slight stretch of the imagination it may be presumed to illuminate the gilt letters of the title shown below.

We learn that Messrs. Arthur Koppel, of 27, Clement's Lane, London, E.C., and Messrs. Orenstein and Koppel have amalgamated. Henceforth the combined business of the two firms in the United Kingdom will be carried on by Messrs. Arthur Koppel, at 27, Clement's Lane, London, E.C. The total combined paid-up capital of the two firms is stated at £1,100,000. Standard types and sizes of all plant previously supplied by either firm, as well as spare parts and fittings for renewals or repairs, will be stocked for immediate delivery.

TRIALS OF 500-B.H.P. DIESEL OIL ENGINE.

THE engine was a three-crank inverted vertical, with three single-acting cylinders numbered 54, 55 and 56, No. 54 being above the idle end of the crank shaft. Each cylinder was 22·05 in. (560 millimetres) diameter, with a piston stroke of 29·53 in. (750 millimetres). The normal speed was 150 revolutions per minute.

The valves were placed in the cylinder covers as usual, and were actuated by levers driven by cams on a horizontal shaft, which in turn was driven by a vertical shaft and bevel gear from the idle end of the crank shaft. The cylinders, cylinder covers, and exhaust valves were water-jacketed, but the pistons were not. The engine drove a dynamo carried upon a prolongation of the crank shaft.

The air for pulverising the oil and spraying it into the cylinders was compressed in an independent pair of three-stage vertical air compressors worked by a two-throw crank shaft, belt-driven by a motor receiving current from the dynamo upon the engine crank shaft. The air compressors, therefore, though essential to the working of the engine, were not in this case parts of the engine, and in calculating the mechanical efficiency of the engine from the dynamo output and the indicator diagrams this fact should not be lost sight of. Had the compressors been driven directly by the engine, the difference between the work put into the dynamo, which is the brake horse-power, and the indicated horse-power, would have been increased by the power required to compress the air.

The areas of the compressor pistons were :—

102·40 sq. in, (660·5 sq. cm.).
32·30 sq. in. (208·1 sq. cm.).
8·79 sq. in. (56·75 sq. cm.).

and the stroke 7·087 in. (180 millimetres), the speed, when compressing to about 64 atmospheres, being about 160 revolutions per minute.

The arrangement, which, of course, is somewhat wasteful, was adopted to meet special conditions. In ordinary cases, it is proposed for engines of this size to use Riedler compressors driven from the engine crank shaft by connecting rods or belts.

The dynamo was 12-pole, continuous current, shunt wound, by Lahmeyer and Co., rated to give 450 [illegible] at 550 volts when [illegible] revolutions per minute. The efficiencies given by the makers are :—

	k.w.	k.w.	k.w.	k.w.	k.w.
At [illegible] ..	[illegible]	225	[illegible]	[illegible]	562
Efficiency about ..	·88	·925	·935	·94	·935

and these figures have been adopted in calculating the brake horse-power of the engine corresponding to the measured output of the dynamo.

The power was absorbed by iron wire resistance coils, and the load regulated by appropriate switches. The motor for driving the air compressors was 6-pole, shunt wound, continuous current, by the same makers, rated to give 75 b.h.p. at 630 revolutions per minute.

The calculated efficiencies given by the makers are :—

At	Full load.	Three-quarter load.	Half load.	Quarter load.
[illegible] ..	[illegible]	[illegible]	[illegible]	[illegible]

DETAILS OF THE FOUR TRIALS MADE.

Four trials were made, the results of which are shown on the accompanying tables.

The first, a preliminary trial, intended to be at full load but actually a little below, the second at full load, the third at half load, and the fourth with no external load, the engine driving the air compressors only, and, of course, the dynamo and motor which transmitted the power to them.

With respect to the figures in the table, the follow- [illegible]

Line 4.—The diameter of the cylinder of No. 56 engine was gauged. The diameters of the other two were taken from the drawing.

Line 6.—The revolutions were recorded by an engine counter, and the speed indicated by a tachometer.

Line 7.—The water for the jackets was supplied from the town's main, and measured through a water meter which was said to have been recently calibrated.

Line 9. The discharge pipes from the jackets were conducted to a common pipe discharging into a drain. The same thermometer was used for measuring the [illegible]

[illegible] exhaust was measured close to the engine by a mercury thermometer [illegible] pipe with [illegible] prevent the latter boiling.

All these observations were taken at intervals of ten minutes.

Line 13. The oil used was from Galicia, costing 100 francs per 1 000 kilos (£4 per ton), delivered at the works. There is considerable doubt about the calorific value of the oil.

The oil used was very carefully weighed in order to remove any doubts which might be raised by the figures in the heat account of trial III.

Lines 17–19.—The mean effective pressures were calculated from indicator diagrams taken at intervals of fifteen minutes.

It will be seen that the mean pressures in the different cylinders differed considerably.

To afford some check upon the dynamo efficiencies given by the makers, the C^2R losses in the armature and [illegible] coils and in the shunt regulator were measured. With the full load of 350 kilowatts these were as follow:—

C^2R loss in armature brushes, etc. ..	8·9 k.w.
,, ,, shunt coil	3·0 ,,
,, ,, shunt regulator resistance ..	2·5 ,,
Total	14·4 ,,

Assuming the iron losses and friction (which could not be measured) to be equal to the above, the total losses would amount to about 28·8 kilowatts, giving an efficiency of 92·4 as against 93·5 claimed by the makers.

Line 22.—The brake horse-power given in this line is at each load the measured output of the dynamo in horse-power divided by the co-efficient of efficiency

	No. of Trial		I	II	III	IV
1	Date		13th Feb.	14th Feb.	14th Feb.	14th Feb.
2	Time		3 55 p.m. to 5 55 p.m.	9 17 a.m. to 11 12 15	11 21·15 to 1 30 15	2·1·30 to 2·59 30
3	Duration	mins.	120	115·25	129	58
4	Diameter of cylinders	ins.	22·05	22·05	22·05	22·05
5	Stroke of pistons	ft.	2·4605	2·4605	2·4605	2·4605
6	Revolutions per minute		150·16	152·8	[illegible]	150·2
7	Jacket water per minute		166·8	169·85	157·85	140
8	Initial temperature of jacket water	Fah.	46·3	46·3	46·3	46·3
9	Final temperature of jacket water	Fah.	125	127·4	104·6	82·1
10	Temperature of outside air	Fah.	48	48	48	48
11	Temperature of exhaust gases	°Fah.	783	806	490	275
12	Analysis of exhaust gases	CO_2	5·6	6·8	3·2	
		N	42·9	51·3	21·5	
		Air	51·5	41·9	[illegible]	
13	Oil used	lbs.	390·3	398	221·1	44·23
14	Oil used per hour	lbs.	195·1	207·2	102·8	45·76
15	Blast pressure	atm.	61·5	66·3	[illegible]	35
16	Maximum pressure shown by indicator diagrams	lbs. per sq. in.	510 515 525	515 525 700	490 480 [illegible]	485 480 [illegible]
17	M.E.P. on first piston No. 54	lbs. per sq. in.	82·9	80·7	71·6	23·2
	,, on second piston No. 55	,,	92·3	93·9	52·6	20·10
	,, on third piston No. 56	,,	110·0	115·6	64·8	33·9
18	Average M.E.P. in the three cylinders	,,	95·05	96·7	66·33	25·4
19	Indicated horse-power		609·3	634·8	363·6	163·5
20	Oil per I.H.P. per hour	lbs.	0·3202	0·3264	0·2828	0·280
21	Output of dynamo	kw.	333	352	168·2	22·24
22	Brake horse-power of engine	b.h.p.	475·5	502·5	245	58
23	Horse-power absorbed in friction		133·8	132·3	118·6	108·7
24	B.H.P. / I.H.P.		0·78	0·802	0·675	0·354
25	Oil per kilowatt hour	lbs.	0·586	0·588	0·613	2·057
26	Oil per brake horse-power per hour	lbs.	0·4106	[illegible]	[illegible]	0·838
27	Power absorbed by motor	kw.	38	41	31·6	23·6
28	Horse-power given out by motor	h.p.	44·8	48·3	36·8	26·2
29	Indicated horse-power of compressor cylinders	i.h.p.	36	40	28·8	18·2
30	Power absorbed in belt and compressors	h.p.	8	8	8	8
31	Estimated brake horse-power of engine deducting mean of lines 29 and 27 from line 21	b.h.p.	435·1	458·7	213·8	324
32	Estimate of mechanical efficiency of engine if pump had been driven by it		0·715	0·723	0·588	0·198
33	Oil per brake horse-power	lbs.	0·444	0·451	0·481	1·415

THE ABOVE TABLE GIVES DETAILS OF THE FOUR TRIALS MADE.

HEAT OIL ACCOUNTS

	TRIAL I		TRIAL II		TRIAL III		TRIAL IV	
	B.T.U.	Per cent	B.T.U.	Per cent.	B.T.U.	Per cent	B.T.U.	Per cent
To [illegible]	[illegible]	100	20,050	[illegible]	20,050	[illegible]	[illegible]	100
By Heat equivalent of work done	[illegible]	[illegible]	7,794	38·9	[illegible]	[illegible]	[illegible]	45·3
Heat carried off in jacket water	[illegible]	[illegible]	4,110	[illegible]	5,300	26·4	6,570	[illegible]
Heat carried off in exhaust gases	7,030	35·1	6,056	30·2	[illegible]	[illegible]	4,402	[illegible]
Radiation and error	[illegible]	[illegible]	2,090	[illegible]	1,438	[illegible]		
	[illegible]	[illegible]	[illegible]	[illegible]	20,050	100·0	20,050	100·0
To [illegible]	[illegible]	100	100	[illegible]	[illegible]	[illegible]	[illegible]	100
By Heat equivalent of work done	[illegible]	[illegible]	42·4	[illegible]	[illegible]	[illegible]	42·4	45·3
Heat carried off in jacket water	[illegible]	[illegible]	[illegible]	[illegible]	25·6	[illegible]	[illegible]	32·8
Heat carried off in exhaust gases	[illegible]	[illegible]	32·9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Radiation and error	[illegible]	[illegible]	11·4	10·4	-6·8	[illegible]		
	107·0	100·0	109·0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

HEAT ACCOUNTS

	TRIAL I		TRIAL II		TRIAL III	
	B.T.U.	Per cent.	B.T.U.	Per cent	B.T.U.	Per cent
To [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	100
By Heat equivalent of work done	7,886	39·3	7,893	[illegible]	[illegible]	[illegible]
Heat carried off in jacket water	[illegible]	[illegible]	4,353	21·8	4,790	23·9
Heat carried off in exhaust gases	[illegible]	[illegible]	[illegible]	30·4	6,950	34·6
Radiation and error	[illegible]	[illegible]	1,704	[illegible]	[illegible]	-3·2
	20,050	100·0	20,050	100·0	20,050	[illegible]

given by the makers for that load. It includes the power absorbed by the motor and air compressor.

Lines 27 and 28.—Give the kilowatts supplied to the motor which drove the air compressors and the horse power given out by it.

The difference of 8·8 h.p. between this figure and the figure 44·8 in the first column of line 25 represents the power absorbed by the driving belt and the mechanism of the compressors.

HEAT ACCOUNTS.

The high percentage of heat unaccounted for on the second trial may be due to imperfect combustion, especially during the earlier part of the trial, when for a short time there was a little smoke from No. 56 cylinder, and the excess of heat accounted for on the third trial is most likely due to over-estimation of the weight of the exhaust gases. This weight varies inversely as the percentage of CO_2 in the gases, and any leakage of air into the gas sample reduces this percentage and consequently unduly increases the calculated weight of the gases.

During the two full-load trials the temperature of the exhaust and of the discharge from the jackets continued to rise for some time after commencement of each trial, while during the half-load trial both temperatures fell. The inference is that during the earlier parts of the two first trials the temperature of the cylinder walls and pistons was increasing by absorption of heat from the gases, and during the third was falling by imparting heat to the gases. To show the effect of these exchanges of heat, heat accounts have been calculated for the periods during which the temperature conditions were fairly constant. The effect upon the oil consumptions and thermal efficiencies was practically negligible.

The distribution of the oil in equal quantities to the cylinders of a multiple-cylinder engine presents difficulties which have not yet been overcome.

IS MACHINE STOKING ECONOMICAL?

By Alfred W. Bennis, M.I.Mech.E., A.I.E.E.

POSSIBLY the most complete answer to this question is that at the present time there are millions of boiler horse-power machine-fired. The most careful and elaborate tests made by the manufacturers of mechanical stokers, and the engineers representing the companies who use these stokers, have indisputably demonstrated that mechanical stoking—machine-firing—is in every way more economical than manual stoking—hand-firing.

To crowd on as much coal at a time as the furnace will hold—the bigger the lumps the better—to shut the door and then trust to luck, has already been laid down by a member of the Institute of Electrical Engineers as the "main object in life of the average human stoker," and all who have practical acquaintance with the type will agree as to the accuracy of this description.

And here we would point out that the term "average fireman" implies that there is a fireman who may distinctly claim to be "beyond the average." Such a man recognises that the principle of good stoking is to fire lightly and often, and to keep the fires as regular and even as possible, and it is his constant aim to regulate the draught to the duty required, keep a clear fire, and an even steam line.

It is a recognised fact that in the actual manipulation of fires the efficiency of the individual fireman, even of the most expert, varies widely. This fact has been attested again and again by a most careful system of prolonged comparative tests made to determine the fuel economy of boilers and engines combined when running at constant load, the furnace and boiler design being similar and the furnace fired by the skilled fireman of the manufacturer. Under these circumstances the variation in results was as much as 15 per cent.

PERSONAL EQUATION IN STOKING.

In order to illustrate the personal element introduced in good and bad stoking we may quote the competition which was carried out at Messrs. Davy Bros., of Sheffield. Five stokers were made to fire the same boiler with the same coal and with the steam pressure about the same. The best stoker was able to obtain an evaporation of 9 lb. of water per lb. of coal, the worst evaporation being 7 lb. per lb. of coal.

It is the results of such tests which bring out so clearly the possibility of this variation in hand-stoking, that provide one of the strongest arguments in favour of the production of the mechanical stoker.

In a paper read before the Ohio Society of Mechanical Electrical and Steam Engineers for the purpose of showing the relative cost of hand-firing in large plants, when compared with modern coal-handling equipment, combined with mechanical stokers, the cost of hand-firing compared with mechanical stoking is given as follows:

May, 1900. Sixteen firemen and one helper; wages £196 7s. 2d.; tons burnt, 4,292; cost per ton, 10·9d., 799d.

Eleven coal and ashmen: wages, £126 18s. 8d.; cost per ton, 7·0d., 978d.

May, 1901. Three firemen and two helpers, wages £57 11s.; tons burnt, 6,975; cost per ton, 1·9802d.

Eleven coal and ashmen, £130 18s.; cost per ton, [illegible].

The saving in wages per ton handled is thus shown to be 11·5935d., which, estimating 6,975 tons per month, is a saving of over £4,000 per annum.

COST OF BOILER-ROOM LABOUR.

An item of great importance in deciding upon the methods of handling coal in steam-power plants is the cost of boiler-room labour. An estimate which is probably not far from accuracy is that which puts the cost of moving coal in hand or wheel-barrow at 6d. per ton for short distances. One man, besides one night man, can run an engine and fire about ten tons of coal per week. One man, besides an engineer and night man, can fire about thirty-five tons per week. These figures do not admit of the night man refusing such work as banking, cleaning, and starting, and are for average conditions. When the coal has to be wheeled for long distances a fair allowance should, of course, be made.

When boiler houses are small, or by reason of their arrangement, an elevating and conveying plant cannot be conveniently put down, the use of small elevators is advocated, either one elevator to each boiler, or one to every two boilers. Take a case in point, a firm has two boilers [illegible] Wages one engineer, £2 5s., one fireman, £1 10s.; total, £3 15s.

With an elevator to the stokers a lad at 16s. per

week can comfortably keep steam and still have plenty of time for keeping the boiler house clean, under the supervision, of course, of the engineer. The wage bill would then be: One engineer £2 5s., lad 16s.; total, [illegible]

The elevator would cost, say, £60; upkeep, say, 5 per cent., £3; oil, etc., £2.; so that the saving would work [illegible] weeks [illegible] = [illegible] 50 per cent. on the outlay.

Many firms are going in for this kind of plant.

One is Messrs. Rowntree, the chocolate manufacturers of York, who are stated to be making a saving of over £2,000 per annum on an outlay of less than £1,200 for stokers and elevators on the five Lancashire boilers.

AN ANSWER TO THE CRITICS.

Turning to a consideration of some of the objections advanced by more or less experienced persons to the use of machine-firing the following may be mentioned: (1) There is no economy; (2) The lower grade coal is not worth burning and in any case it smokes; (3) The cost of upkeep is excessive; (4) Where the load varies machine-firing has to be supplemented by hand-firing; (5) The machine is frequently out of order; (6) Machine stokers reduce the capacity of the boiler.

Taking these objections in order, we would say that (1) it is customary now, with all manufacturers of first-class machinery of the kind to instal it with a guarantee of saving. The economy effected varies between 25 per cent. and 200 per cent. on the outlay, i.e., on the initial cost of the machinery.

(2) With regard to this objection I would assert on behalf of the manufacturers of this type of plant that very many practical tests have established the claim that the work done, whether with low or high-grade coals, is practically the same.

The Glamorgan Coal Company, Ltd., one of the largest collieries in South Wales, recently made some elaborate trials of stokers and hand-firing. Hand-firing evaporated about 6,000 lb. of water per hour. The stoker on the same boiler gave with colliery small, 9,469 lb.; unwashed peas, 11,142 lb.; washed peas, 11,335 lb.; washed nuts and beans, 10,160 lb.; unwashed beans, 9,720 lb.; unwashed nuts, 10,390 lb.; washed colliery small, 10,684 lb.; dry duff, 8,301 lb.; so that the variation in evaporation obtained on the same boiler with these different fuels was never very great; though the price varies many shillings per ton between the best and worst of the lot, and curiously enough, the coal which gave the best economical efficiency, the washed nuts and beans, [illegible] not give the highest evaporation.

(3) In answer to the third objection it may be said that if stokers are reasonably looked after, the cost of upkeep does not amount to 10 per cent. on the saving made by the machines.

(4) This objection may be answered by an emphatic denial that there is need for hand-firing if the man in charge knows what he is doing, and in this connection it may be pointed out that machine-stoked dye-houses work without hand-firing, and the dye-house load is admittedly more variable than even the electric power-station load.

Thousands of stokers are now conveyor-fed; these could be easily hand-fired even in regular work if it were so desired.

(5) Against this objection we have the fact that many mills, with but one or two boilers, employ these stokers, which they could not do if constant breakdowns were the order of the day. It is, at any rate, a general rule with my own firm, as also with others of equal standing, to guarantee a greater evaporation by 25 per cent. to 50 per cent. from any coal than that obtained by hand-firing with the same coal.

(6) Machine firing does not reduce boiler capacity; it increases it. In a series of tests carried out on marine boilers with hot air at the Sheffield Corporation Sheaf Street Electricity Works, by Mr. S. E. Fedden, A.M.Inst.C.E., M.I.Mech.E., the following facts, which are not without significance, were established:—The rated capacity of the boilers with hand-firing was 9,000 lb., to 10,000 lb. of water per hour; with mechanical firing and hot air, 17,652 lb. of water were evaporated per hour, with an efficiency of 79·9 per cent. These tests brought out most clearly the high efficiency attainable, with an increased evaporation of about 80 per cent., and this with small slack coal.

FALSE ECONOMY.

I should here like to enter my protest against the false economy of the users of steam power who make it a constant rule to buy the cheapest machines, i.e., a machine for which the smallest initial outlay is required. Here is a case in point. Two stokers were installed for a firm known to me, one costing 50 per cent. more than the other. In less than a year the [illegible] the difference four times over; in other words, it had saved twice the cost of the cheaper machine.

[illegible] speak for themselves.

[illegible] electrical [illegible] Mr. Joseph A.

Jeckell, the manager of the electricity department of the Corporation of Coventry, read before the members of the Birmingham Electric Club, figures are given showing the results of working at the Corporation Electricity Works, Coventry.

In 1901 the station cost pence per unit was 3·05d. In May two boilers were fitted with high-class stokers and in October, 1902, two more boilers were fitted. In 1902 the costs went down to 2·43d. In 1903 when the costs were effected by the change in the stoking, the station costs went down to 1·51d. In 1904, they went down to 1·16d. In 1904 two more boilers were fitted with these machines and in 1905 the Coventry costs stand at ·85d., which is a world's record. They previously had at work a cheap stoker, and the test in 1902 showed briefly that the dearer machine gave the extra evaporation per hour of $17\frac{1}{2}$ per cent. with a reduction in fuel cost per 1,000 gallons of 53 per cent.

Possibly another cause to which these detrimental views of the mechanical stoker may be attributed is the fact that many badly-designed stokers have been placed on the market, causing actual loss instead of gain.

History repeats itself. The old story of the compound or single-engine controversy is now being repeated in boiler-firing. The single cylinder is hand-firing; the compound engine, machine-firing; and the arguments used in the great Oldham controversy are much the same, but the evolution and survival of the fittest must result.

Abstract of a Paper read before the Keighley Association of Engineers.

NEWS ITEMS.

The Great Western Railway Magazine places on record the fact that from the commencement of the services on August 17th, 1903, to September 30th, 1905, the G.W.R. Company's road motor cars have carried 1,450,671 passengers, and run 607,640 miles without a fatal accident of any kind either to passengers, the public, or the company's servants.

The memorial bust of Dr. Joule, the discoverer of the mechanical equivalent of heat, was unveiled last Saturday afternoon at Sale, near Manchester, the ceremony being performed by Sir William Bailey, president of the Manchester Literary and Philosophical Society, who gave an appropriate address. On the motion of Mr. Alfred Hopkinson, principal of Manchester University, a vote of thanks was accorded to Sir William Bailey.

Mr. Marconi and the Italian Government.

"A few years ago," says Electrical Industries, "the Italian Government entered into a contract with Mr. Marconi for the establishment of wireless telegraphic services in the navy, and also in association with the Italian posts and telegraphs. In recognition of the encouragement granted to him by the Italian Government during the experimental period, Mr. Marconi gave the Government the benefit of certain inventions; and the signing of the contract, which was twice discussed by the Italian Government, was a formal and convincing step in a long course of cordial association between the Italian Government and an inventor whose descent makes him as much a Briton as an Italian. Recently, however, *L'Elettricista* (a leading electrical journal) and some of the opposition papers have been questioning the wisdom of the Government in making the Marconi contract. They take exception to the grant of a monopoly to the Marconi system for fourteen years, and consider that it is contrary to the interests of the State that Italy should be precluded from accepting the fundamental proposition of the Berlin Conference on Wireless Telegraphy—compulsory communication between all systems. They have also taken exception to the payments under the terms of the contract to Mr. Marconi personally." Mr. Marconi, it appears, wrote to the Italian Minister of Posts and Telegraphs a letter in which he expressed his willingness either to cancel the contract outright or fulfil it to the letter. The reply of the Government, which is set out below, shows that it is convinced of the value of the conditions entered into, and is determined to proceed with the arrangement in spite of the newspaper clamour.

The Minister of Posts and Telegraphs cabled as follows: "The tenders for work at Coltano Station will be invited at Pisa, 18th inst. The Ministry in thus putting into execution the Bill twice approved by Parliament, is also convinced of the value of the conditions entered into, and also grateful to the illustrious Italian who generously conceded to his country the use without compensation of the extraordinary fruits of his genius. I beg you not to concern yourself about any discordant opinion, which certainly does not reflect either the feeling of the country or that of the Government."

At a meeting of the council of the Royal Society on the 26th inst., the treasurer announced that he had received from Mrs. Tyndall a cheque for £1,000, which, in accordance with the wishes of the late Professor Tyndall, she desired to have applied to the general purposes of the Society.

OUR WEEKLY BIOGRAPHY.

SIR WILLIAM RAMSAY, K.C.B., LL.D., D.Sc., Ph.D., F.R.S., F.C.S.

THE law of heredity is manifestly substantiated in the life of Sir William Ramsay. Born in Glasgow in 1852, the only son of William Ramsay—the elder brother of the late Sir Andrew Ramsay, the geologist—he was from the very commencement of his career accustomed to a scientific environment. On the paternal side his grandfather, a manufacturing chemist, was founder in 1880 of the Chemical Society of Glasgow. His father practised as a civil engineer, and his mother was a daughter of Dr. Archibald Robertson, of Edinburgh, the author of two scientific treatises well known to students of a former generation.

Educated at the Glasgow Academy, William Ramsay afterwards entered the university, where he pursued the usual curriculum for the M.A. degree. He was engaged concurrently in the laboratory of Mr. Tatlock, an analyst, from whom he received his first tuition in practical chemistry. In 1871 he left his native city and proceeded to Tübingen, where he studied under Professor Fittig, and subsequently graduated Ph.D. After two years in Germany, he returned home and served as an assistant in chemistry at his alma mater. He occupied this position for six years, during which time he associated himself with the new school of chemists whose objects were to investigate the hitherto unexplored region between the sciences of chemistry and physics. Professor Ramsay practically relinquished the study of organic chemistry, and from that time forward his energies have been concentrated on the study of inorganic and physical chemistry.

Among other results of his researches given to the scientific world while he was still at the Scottish university, mention must be made of [illegible] "Atomic Volumes" and the critical state of gases.

In 1880 he was appointed to the chair of chemistry in the Bristol University College. He had spent about twelve months in this position when the principalship of the Institution fell vacant, and the Council, who had already

SIR WILLIAM RAMSAY, K.C.B.

formed [illegible] high estimation of the Professor's skill, demonstrated their increasing confidence by making him principal of the university.

The ensuing period of six years was probably the most strenuous in his life. Professor Ramsay was not only responsible for the duties incumbent upon the principal, but at the same time he continued in his professorial duties, occupying the dual office until 1887, when he was appointed to the professorship of chemistry in the London University. It was about this time that Sir William translated into English a treatise by the eminent Dutch chemist, van 't Hoff. This paper evoked a widespread discussion in which most of the leading scientists of this country participated; it also proved advantageous to the translator by bringing him in touch with the chief foreign chemists.

In 1894 Sir William Ramsay came prominently before the public by his discovery of argon, a previously unknown constituent of the atmosphere. The researches which led up to this discovery were carried out conjointly with Lord Rayleigh, and, in recognition of their labours the two scientists were awarded the Hodgkins prize of the Smithsonian Institution. Remarkable as this discovery was, however, its value lay mainly in the fact that it brought the Professor to the threshold of still greater possibilities. The following year his attentions were engrossed in observing the action of sulphuric acid on certain rare minerals, which were reported to give off nitrogen when heated. Sir William was sceptical as to the possibility of the gas being generated under such circumstances; he therefore resolved to make a personal investigation. Professor Dobbie has related how he prepared the gas from the mineral clevite, and subjected it to examination by the spectroscopic method, throwing the spectrum of argon at the same time into the field of the spectroscope for comparison, and how these experiments resulted eventually in the discovery of helium.

At the Toronto meeting of the British Association, held in 1897, Sir William Ramsay, as president of the chemical section, predicted that there was a third atmospheric gas which, up to that date, had evaded discovery. At the same time he ventured to predict some of its salient characteristics. Within the following five years, his already wide-spread reputation was further enhanced by his discovery in conjunction with his then assistant, Dr. Morris Travers, of krypton, neon and xenon, new atmospheric elements, which were obtained by allowing a quantity of liquid air to evaporate and examining the last traces of the gas given off.

Last year Sir William was engaged in a number of important experiments with radium and the transmutation of metals. It was suggested by Professor Rutherford and Mr. Soddy, of Montreal, that one of the products of decomposition of the emanation from radium salts would prove to be helium. With Mr. Soddy Sir William made a number of experiments to test the theory, and undoubted spectroscopic evidence was obtained that helium is a product of the disintegration of the emanation—a discovery of great importance, marking a new turning-point in chemistry.

The scientific achievements of Sir William have met with universal recognition; he was the first British scientist to receive the Hofmann foundation gold medal; he is an officer of the Legion of Honour; a corresponding member of the Institute of France; and an honorary member of all the foremost scientific associations of Europe. He is the author of three well-known books on chemistry, and has contributed numerous papers to the transactions of technical societies, probably the most important of which are those dealing with his own discoveries.

Sir William Ramsay is a skilful glass-blower, many of the extremely delicate vessels utilised in his work having been made by his own hands. He is an expert linguist, takes a keen interest in the progress of education, and has proved a zealous advocate of State aid for universities.

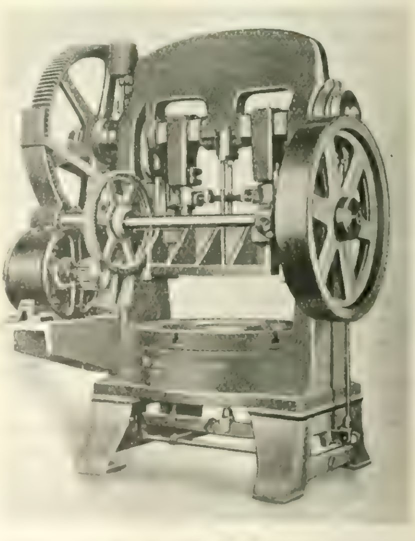
NEW 44-in. GEARED POWER PRESS BY THE TOLEDO MACHINE AND TOOL COMPANY.

We illustrate herewith a press built by the Toledo Machine and Tool Company, Toledo, Ohio, U.S.A., of a new style and pattern, which they describe as their 44-in. No. 93 geared power press. The bracket supporting the motor, and the arrangement of the driving gears for motor, are such that the floor space required for the machine is not greater than the floor space required for the regular belt-driven machines. This press is one of ten sizes now being made of this style, and each of the various sizes is made in several different widths. The distance from bed to slide is 14 in. The area of bed is 44 in. by 44 in. The opening in bed is 34 in. The press is fitted with a positive automatic knock-out.

The automatic knock-out in slide consists of a front and rear vertical bar, the upper end of which is threaded. This threaded portion runs up in the lower cap for centre bearing of crank shaft, a sufficient distance to provide for about 5 in. of adjustment, in order that the front and rear knock-out bars may be adjusted up and down to suit the adjustment or slide. These bars pass entirely through the slide flange or face and are designed to run down through the upper die plate, striking directly on the interior knock-out pad in the upper die, and the lower knock-out is constructed by having a lower cross bar fulcrumed in a clevice on the lower right hand leg of the press, the bar extending entirely across to the outside of the left hand leg of press.

A connection is fitted to a cam on the left hand end of the crank shaft, this connection running down outside of the left hand side of press and connecting with the lower cross bar. The supporting vertical arm is attached to the lower cross bars central with the bed of press. The upper part of this arm is threaded and fitted into a cast-iron plate large enough in area or diameter to suit the opening in press bed, and the largest dies to be operated in the press. The threaded portion of the vertical supporting arm is long enough to permit of ample adjustment for the lower dies. It is intended that the knock-out plate in the lower dies be supported by vertical pins passing down through the lower die plate, and through the press bed plate or bolster; thus coming in contact with the knock-out plate supported on the vertical arm below. Four of the knock-out pins are usually anchored into the lower knock-out plate, acting in this manner as a guide for setting the lower plate.

The press bed is bored central with the slide down far enough to form a wide substantial shoulder in the press bed. This is designed for fitting filler rings in press bed, which are recessed to receive the dies, and in this manner acting as a substantial guide for holding the dies rigidly in position. The bearings for slide of press are constructed with four bearing points as widely separated as the size of the press will permit; the construction of the bearing of this being practically adaptable for the operating of extensive cutting and perforating dies.



44-IN. GEARED POWER PRESS.

OPEN HEARTH MOLTEN METAL PROCESSES.

THE following is a comparison of the various methods which hitherto have been worked to use molten iron in open hearth practice. Okar Simmersbach, the writer, classifies the processes into two groups, first, those in which the oxidation is effected by the oxygen of the air, and, second, those in which iron ore supplies the oxygen. To the former group belong (1) the Duplex, (2) the Daelen Pscholka, and (3) the Kernohan processes, while the second group is represented by (4) the Pig and Ore process and the Methods of (5) Monell, (6) Bertrand-Thiel, (7) Talbot and (8) Surzycki.

THE DUPLEX OR COMBINED BESSEMER AND OPEN HEARTH PROCESS.

The use of the Bessemer converter necessitates an iron with considerable silicon and manganese in order that the sulphur can be kept low at the blast furnace. The Bessemerising effects the removal of the manganese and silicon, so that in the open hearth furnace, where ordinarily most of the lime used is needed on account of the silicon, the formation of a large body of slag is avoided. There is also a partial decarburisation, the extent of which depends upon the amount of phosphorus present, as the formation and action of a good dephosphorising slag in the open hearth furnace require time.

In Witkowitz, where the process was introduced in 1878, when using iron with 1·2 per cent. silicon, 2·7 per cent. manganese, 0·2 per cent phosphorus, 3·7 per cent. carbon and 0·02 per cent. sulphur in the converter, and a charge of ten tons, the blow lasted about eight minutes. The metal then contained only 0·1 per cent carbon, and 0·4 per cent. manganese. A high temperature is necessary to transfer the charge, as, in order to avoid the presence of acid Bessemer slag on the basic hearth, the ladle cannot be tilted, but the charge must be tapped out through the bottom of the ladle. The metal is then dephosphorised in the usual way in the open hearth furnace, which takes but a short time. If no pig iron or scrap is added about three hours are required for each heat.

Although by this process iron containing too much phosphorus for the acid and too little for the basic Bessemer can be converted into steel of excellent quality the cost of installing and operating such a plant is very high, as a mixer and a second converter are practically indispensable in order that an occasional high sulphur cast from the blast furnace shall not necessitate a stop in the steel works. If only one converter is installed and several Bessemer charges are necessary for one open hearth heat the furnace must each time wait on metal and also whenever the bottom is changed. The yield is very low, the vessel loss being very little less than in the ordinary Bessemer practice, as it is mostly in the early part of the blow that metal is thrown out. The furnace loss cannot be replaced by using ore, because the low percentage of carbon and silicon in the bath would be insufficient to reduce it.

THE DAELEN-PSCHOLKA PROCESS.

In this process the chief object is to avoid the transference necessary in the duplex method and at the same time reduce the cost of installation. This is achieved by the use of a converter in the shape of a square ladle, which carries the metal from the blast furnace to the open hearth furnace, and in which preliminary refining is carried out at the former by means of hot blast, introduced at a low pressure from the side and played on the surface of the metal. The latter is then taken to the open hearth furnace, where the charge is completed in the usual manner.

Comparing the two processes, the use of hot blast increases the oxidation in the converter and also the temperature at the surface. The oxidation, however, will not be so complete as if air were blown through the metal, for in the ordinary Bessemer process a 10-ton charge with a blowing engine of 17,600 cubic feet capacity per minute requires eight minutes for completion. An especial difficulty caused by surface blowing is the destructive action of the flame on the wall of the vessel opposite the tuyeres. To avoid this, Daelen has recently introduced a converter of circular form with radial or tangential tuyeres.

The cost of maintenance and operation in this process is considerably less than that of the preceding one. On account of the lower blast pressure the cost for steam is less. Furthermore, the loss is not so great, as is shown by the fact that when using an iron with 2·2 per cent. manganese, 1 per cent. silicon and 3·5 per cent. carbon the loss was only 7½ per cent., carbon being brought down to 1 per cent. This could probably be reduced by the use of metal with 1 per cent. manganese, which would be sufficient for the purpose. Furthermore, when using high silicon iron it is possible to utilise the excess heat obtained

by the combustion of silicon by adding ore which hastens the process and increases the product.

THE KERNOHAN PROCESS.

In this process the molten metal is [illegible] into a long furnace, through which it passes in a shallow stream in an inclined runner, which forms the bottom of the furnace. In this runner tuyeres are set, through which air is blown, thus refining the metal as in a Bessemer converter. As the necessary heat is obtained by the combustion of the silicon and manganese, these elements must be present in sufficient quantity. The depth of metal is only about three inches, so that the large surface and small mass of the bath are extremely favourable for refining.

The action of the blast is more complete than in surface blowing and is even more rapid than in the duplex process, without the necessity of the high pressure required in the latter. At the works of Bolckow, Vaughan and Co., Middlesbrough, the time which the metal required to run through the furnace, using a blast pressure of 10 lb. per square inch, was only five or six minutes. It is, furthermore, convenient that the duration of the blow does not need to be very exact, as it is possible to take tests before transference to the open hearth furnace. After the preliminary refining the metal passes into a runner, in which it is held back by means of a dam, and thus collected until an empty ladle is placed underneath. The operation is therefore continuous and delays at the open hearth furnace are reduced.

The completion of the charge is carried out in the usual manner and with the same speed as in the duplex process. The loss in the Kernohan process amounts to about 9 per cent., which cannot be reduced by the introduction of ore. The lining of the first furnace suffers considerably and the repairs to its bottom do not cost much less than the Bessemer. Changing the tuyere is not by any means a simple operation, so that long delays occur, which would seem to make the installation of an extra furnace of the same type desirable. However, this method of operation costs less for maintenance by reason of the simplicity of the [illegible] arrangements, [illegible] low cost of installation.

THE PIG AND ORE PROCESS.

In the processes previously described the oxidation is carried out by means of impure oxygen, as the air contains 77 per cent. of other elements, while when indirect oxidation is made use of to refine and decarburise the iron the pure oxygen of iron oxide is used, which, however, must first be separated from the ores, necessitating a great expenditure of heat. This use of heat to break up the oxides of iron forms an important factor in judging processes which use indirect oxidation, as may be seen by the following consideration :—

The reduction of ferric oxide by molten iron is effected in two stages. First in the formation of ferrous oxide by means of carbon, which consumes heat amounting to 204 calories per pound of iron. According to the formula, $C + Fe_2O_3 = CO + 2FeO$, each pound of carbon converts 13·3 lb. of Fe_2O_3, containing 9·3 lb. Fe, into FeO.

	Calories.
In this reaction one pound of C develops	1,120
The reduction of the Fe_2O_3 to FOe requires [illegible]	1,897
Heat consumed	777

The ferrous oxide thus formed is then at a lower temperature, reduced principally by silicon, manganese and phosphorus, but as the temperature increases there is a greater tendency to combustion on the part of the carbon. For silicon the formula is $Si + 2 FeO = SiO_2 + 2 Fe$, and as the atomic weight of silicon is exactly one-half that of iron (28 : 56), 1 lb. of the same reduces 4 lb. of iron.

	Calories.
In this re-action 1 lb. Si develops by combustion	3,552
4 lb. Fe reduced from FeO requires 4 × 612 ..	2,448
Heat gained	1,104

Manganese reduces according to the formula Mn + [illegible] as follows:—

	Calories.
[illegible]	785
[illegible]	612
[illegible]	173

[illegible] according to the [illegible] each pound of [illegible]

	Calories
1 lb. P develops by oxidation	2,676
[illegible]	2,754
Heat consumed	78

[illegible] formula [illegible] 4·7 lb. [illegible]

[illegible]	1,120
[illegible] ..	2,876
Heat consumed	1,756

[illegible] methods [illegible] open hearth [illegible] the heat [illegible] elements in

the pig iron is used to disassociate the ores, a consideration which especially in the case of phosphorus, deserves notice. Favourable for the development of [illegible] and all other processes with molten metal is the circumstance that the greater the amount of the reducing elements (Si, Mn, P, C) present the greater is the amount of ore reduced, and, as a matter of fact, the product of a furnace when making steel not [illegible] in carbon increases as much as [illegible] per cent.

It was to be expected therefore that by this method the loss of the manganese and metalloids would be replaced from the iron reduced from the ore, as was the case at the works of the Glasgow Iron and Steel Company, where, when using an addition of 30·6 per cent. ore a product of 99·2 per cent. of the metal charged was obtained. In proportion, however, to the amount of ore added the body of the slag increases, which results in various difficulties; especially will the lining in the furnace be attacked, so that its life is short. Furthermore, the output of the furnace is reduced, as the reduction of the ores requires a longer time. The time of the heat in Wishaw was eight hours and at Witkowitz, with 20 to 22 per cent. addition of ore and 10 per cent. scrap, ten hours, and at the same time the labour and fuel costs increased.

In view of this fact the ore process in its original form for iron with a medium percentage of phosphorus did not find many users. With iron containing less than 0·1 per cent. phosphorus and 0·2 per cent. sulphur the prospects are changed. Under favourable conditions when using an easily reduced ore with 68 per cent. iron as much as 85 per cent. of the latter can be got out, so that a yield of 105 per cent. may be achieved.

THE MONELL PROCESS.

A. Monell of Pittsburgh developed the pig and ore process by charging limestone and ore into the basic open hearth furnace and thoroughly heating these materials before the molten metal is poured in. The iron contained 3·9 to 4·1 per cent. carbon, 0·5 to 0·8 per cent. phosphorus, 0·5 to 0·9 per cent. silicon, 0·8 to 0·9 per cent. manganese and 0·04 to 0·07 per cent. sulphur. An hour after the introduction of the metal the bath is free from the phosphorus, silicon and manganese, while the carbon is reduced to about 2 per cent. After removal of the phosphoric slag the temperature is increased and the metal is decarburised in the usual manner.

The preliminary heating of limestone and ore before charging the iron is a step in advance. The furnace [illegible] the phosphorus is [illegible] quickly separated and the time of the heat is correspondingly [illegible]. On the other hand the use of [illegible] fused ore and limestone tends to stick to the bottom of the hearth, so that in time the capacity of the furnace is reduced.

The reaction when pouring hot metal on the ore and limestone is not so violent as if they were molten, but during the period a foamy mass is formed and as much as 80 per cent. of the slag runs off, accompanied, however, by no small amount of iron. This period of foaming, caused by the low temperature of the iron from the blast furnace, causes the decarburisation to be slower, and, as no short time is needed to charge and heat up ore and limestone, the output of the furnace is not all that could be desired. The production of a 40-ton furnace in six days amounts to 662 to 718 tons. The loss is made up by the ore charged, and there is even a gain of 2 or 3 per cent., but the relative amount of ore reduced is still low.

THE BERTRAND-THIEL PROCESS.

In this process an endeavour is made to divide the addition of ore into two periods and between two basic furnaces, and by the separation of the inactive slag before the second addition of ore to increase the efficiency of the bath of iron in the second furnace. In the first furnace a part of the lime and ore, together with solid pig-iron, is charged and molten metal added to the same. When the boiling period begins a further addition of ore and lime is made, enough being added so that the silicon and manganese are completely removed, the phosphorus reduced to 0·01 or 0·02 per cent. and the carbon to about 2 per cent. This stage is reached in two and one-half hours from the beginning of the charge and the re-action then ceases.

The partially refined metal is now separated from the slag by transferring the metal to a second open hearth furnace, where it is poured upon heated scrap and limestone, after which, by the addition of fresh ore and limestone, a new slag is formed. During this period the metal increases rapidly in temperature, as it is only covered by a comparatively small amount of slag. As the latter is not thinned and weakened by the old cinder and has in consequence iron in excess, the mutual action of the two is intensified, so that decarburisation takes place very rapidly.

If the addition of the ore in the first furnace is measured in the method indicated, the period of completion is about the same as that of the preliminary refining, so that delays are avoided. The total time of the heat amounts to five or six hours, so that each furnace works four to five charges per day—that is, double as much as in the other ore processes. The yield is as high as in the Monell process, up to 103 per cent., and the slag from the first furnace contains a percentage of

phosphoric acid which makes it of equal value as that from the basic Bessemer.

The disadvantages of the pig and ore process appear also in this to a greater or less extent, especially the wear on the lining, which is very considerable in the first furnace, but on account of the smaller amount of slag is less in the second. These disadvantages, together with those occasioned by the transference from one furnace to another, are counterbalanced by the production. At the Hoesch Steel Works, in two furnaces of 27 tons capacity, there were produced in 24 hours 190 tons, as against 175 tons in the scrap furnace. This figure can be considerably increased if the period in the first furnace is shortened by means of preliminary heating of the ore and limestone. By this means the yield would also be increased, as hitherto 25 per cent. of the refining has been carried out by the oxygen in the gases, so that if the time of the heat is shortened the furnace gases will have a less oxidising effect and will therefore make necessary a great addition of ore. At the same time by preheating the ore and limestone the regularity of operation will be increased.

It must not be forgotten that when working high phosphorous iron the low temperature in the first furnace is favourable to the separation of phosphorus which concentrates in the preliminary slag, whereas at a higher temperature the carbon burns more rapidly than the phosphorus, and then the larger part of it, up to 50 per cent., does not enter the slag until it reaches the second furnace.

Regarding the quality of ores used, those which are siliceous and low in iron should be avoided, as an increased body of slag is opposed to the main principle of the process and to a certain extent makes its advantages illusory. Iron of any composition can be used in this process, but a high percentage of manganese is a disadvantage, as it delays the operation. Phosphorus, on the other hand, on account of the increased value of the slag, is not undesirable.

THE TALBOT PROCESS.

In this process, in order to increase the temperature of the bath, the fluid iron is mixed in with a bath of steel, whereby the temperature of the iron, aided also by the combustion of the gases, is raised in a short time from 1,200 deg. C. to that of the steel—that is, 1,500 to 1,700 deg. C.—whereby the action of the oxide of iron on the fluid metal is intensified.

When starting a Talbot furnace of 100 tons capacity at Frodingham, England, the furnace is first filled with 50 tons of scrap in small charges. When this is melted down, roll cinder or ore and limestone are added in [illegible] Fifteen tons of molten iron are then added slowly without shutting off either gas or air. When the re-action is at an end and the bath has become quiet, ore and limestone are again added and another 15 tons are poured in, and this is continued until the furnace is full. When the heat is so near completion that only small bubbles appear, the slag is run off through a slag hole by tilting the furnace, and the charge is dephosphorised with burnt lime, lump ore being added at the same time. When the metal has become sufficiently hot and soft the furnace is tilted and 25 to 30 tons of steel are poured into the ladle. Into that remaining in the furnace roll cinder or ore is added, which is rapidly taken up by the remaining slag which now contains but few oxides. By the time the necessary repairs are made to the banks the slag is in such condition that an addition of 25 to 30 tons of molten iron can be made without further delay. While this is being poured in the gas and air are completely shut off, as the furnace rapidly becomes hot by reason of the combustion of the elements of the iron. When the iron is all in the temperature of the bath increases because the carbon monoxide formed by the carbon combining with the oxygen in the slag burns on the surface of the bath when it comes into contact with the oxygen in the gas. As a result the preliminary refining of the iron is completed in from 30 to 40 minutes. The charge is finished in the ladle with anthracite and ferromanganese.

The main feature of the Talbot process is the continuously high temperature of the furnace, which results in accelerated action of the iron oxides, and instead of the bath simmering for hours, as is the case with the other ore processes, a violent boil results, which is the more active as the bath is low in carbon, never exceeding 0·5 per cent. The larger the furnace—that is to say, the more steel that remains in it—the greater is the surplus heat in the bath and the more easily will the variations in temperature be taken care of, which result from the nature of the ore process in general and from shutting off the gas each time the furnace is tilted. The rapidity with which the carbon of the molten metal is removed is shown by the fact that within 27 minutes the carbon is reduced from 0·46 to 0·15 per cent. and in 7 minutes from 0·55 to 0·44 per cent., a circumstance which makes the production of hard steel, such as used for rails, axles, etc., considerably more simple.

[illegible] decarburisation the energetic re-action between metal and ore results in a [illegible] than in other [illegible] of them being [illegible] per cent. [illegible] of the ore. At

Frodinglam a material with 45 per cent. iron, 8·70 per cent. silica, 6·24 per cent. alumina and 10·80 per cent. lime is used. The composition of the iron is also not so particular, as the large bath of disiliconised metal is capable of taking care of high silicon in the iron without injury to the lining. If the iron contains manganese there is a separation of the sulpur similar to that which takes place in a mixer. A high percentage of phosphorus has the disadvantage of lengthening the process of dephosphorisation, but on the other hand an iron with 1·8 to 2 per cent. of phosphorus, as used at Frodingham, yields a slag with over 16½ per cent. phosphoric acid. A further advantage of the large bath consists in the fact that the bottom of the hearth does not come in contact with the slag and is therefore protected.

The production of the Talbot process is considerably higher than in the other ore processes, as a 100-ton furnace yields 25 tons of steel every three hours. A 200-ton furnace yields still more, because a larger amount of fluid steel is left in the furnace and because when 20 tons are tapped the time lost is not much less than if 40 tons are put into the ladle. At Frodingham a Talbot furnace makes 36 heats in a week, while the old style 40-ton furnace working with 70 per cent. of pig iron and 30 per cent. scrap makes only eight heats. In Pittsburgh a 175-ton Talbot furnace of the Jones and Laughlin Steel Company produced 1,600 to 1,700 tons of steel weekly, and gave such satisfaction that four more such furnaces have been built to produce 325,000 tons yearly.

Instead of the molten metal it is possible to work with an addition of scrap, which is quickly melted in the big bath of steel without loss by oxidation, which is hindered by the covering of slag. This fact adds considerably to the value of the Talbot process, since it makes it possible to smelt large quantities of iron ore in spite of its low specific gravity, so that by increasing the amount of ore charged from 20 to 40 per cent., it is possible to increase the yield to 115 per cent.

THE SURZYCKI PROCESS.

The object of this process is to introduce continuous working in the same manner as that of the Talbot process without the necessity of using a tilting furnace. With this object the furnace is provided with two tap holes at different levels, which lead into a double runner, so that the slag and part of the metal can be removed from the furnace without completely emptying it. Cold scrap is first melted in the furnace and to this molten iron is added. When the bath has become quiet a considerable amount of ore is thrown in, followed by more molten metal, and this is continued until the furnace is full. Dephosphorisation is carried out in the usual manner with lime, and when decarburisation has proceeded to the point desired a part of the metal is run out through the upper tap hole into the ladle, where it is finished by means of charcoal and ferro-manganese. The tap hole is then closed with burnt dolomite, the banks are made up, ore or roll cinder is added and another charge of molten metal is thrown in. The tap hole of a 40 to 50 ton furnace is so placed that 25 to 30 tons of finished metal may be poured off and 20 to 25 tons left in the furnace. The lower tap hole is only used when it is necessary to completely empty the furnace.

In Czenstochau, where Surzycki introduced his process in 1902, using an iron with 0·6 per cent. phosphorus, 20 to 25 per cent. ore and a yield of 102 per cent. of the metallic charge, the product was 75 to 90 tons of steel—that is to say, an increase over the pig and ore process of 15 to 28 per cent, Compared with the Talbot process there is, however, a considerably smaller yield and diminished capacity, the cause of which is the greater dilution of the bath in the Talbot process, the percentage of carbon in the stationary furnace being twice as high as in the Talbot. Another reason is in the greater surplus of heat, which makes better regulation of the operation possible. The output is also smaller than that of the Bertrand-Thiel process, even when it is taken into consideration that the furnace at Czenstochau is only 8½ ft. wide, 20 in. deep and not well constructed. The low output naturally increases the running expenses. The first cost of a stationary furnace with the tapping arrangement described is of course, considerably lower than that of a tilting furnace, but it must not be forgotten that this arrangement naturally increases the danger of a heat breaking out.

Of the processes described the Bertrand-Thiel and the Talbot processes have entered into effective competition with the older methods of working, but the scrap melting process holds the field wherever old material is available at a sufficiently low price. One of the disadvantages of the Bessemer process, either acid or basic, is that of restriction to an exact iron analysis, while the Bertrand-Thiel and Talbot processes permit of the use of an iron of almost any composition. Furthermore, the latter permit of the use of scrap to any extent desired, which is not the case with the Bessemer. There is no doubt that the future belongs to the Bertrand-Thiel process, where quality and variety are wanted, and the Talbot, where large quantities of one kind of steel are required. Neither process must be regarded as completely developed, and that of Talbot especially is capable of being still further improved.

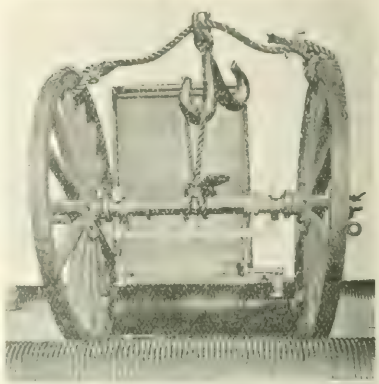
[illegible]

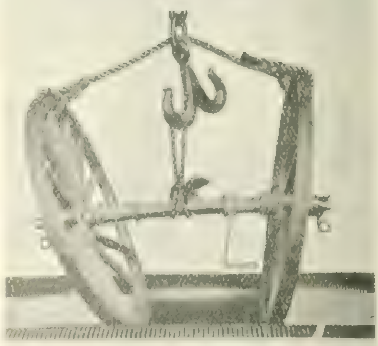
METAL TESTS AT WATERTOWN ARSENAL.

THE annual report of tests of iron and steel and other materials made at Watertown Arsenal and drawn up by Major Frank Baker, of the Ordnance Department, United States Army, has just come to hand, and as usual, covers a wide range of subjects interesting to engineers. It appears that during the fiscal year ended June 30th, 1904, 3,719 specimens were tested. They are classified as follows :—

Gun specimens	129
For Ordnance Department ..	2,231
For other Government departments	59
Investigative tests	538
Tests for private parties ..	762
Total	3,719

Much of the routine work of the testing department pertained to arsenal material. Tests on ordnance material were made on each of 234 days during the year. Further examination was made of the metal in gun forgings which showed the presence of streaks therein. Proof stresses were applied to piston rods and retraction ropes. Helical springs, copper cylinders for pressure gauges in the determination of powder pressures, mountain gun carriage wheels and axles, and gun wire were among the specimens tested on account of the Ordnance Department. Additional tests were made of the metal from a carbon-steel ingot of the grade of steel used in gun forgings. The tests were with specimens which had been forged at different temperatures, some of which were afterwards subjected to heat treatment. There were retests of wrought iron, following a period of rest of twenty-two years intervening since the original





[illegible] WHEELS [illegible]

[illegible]

No. of test	Marks.	Forging heat	Reheated to—	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 3 inches.	Contraction of area.	Appearance of fracture.
				Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	
8015	1*	Low forging	Not reheated	57,500	99,840	21.3	41.9	Fine, silky.
8016	1**	do	Blood red	56,000	96,000	21.3	47.2	Do.
8017	1***	do	Low cherry	56,000	94,000	25.0	41.6	Do.
8018	2*	do	Full cherry	52,000	95,000	19.0	49.7	Do.
8019	2**	do	Low yellow	57,000	92,400	22.3	47.2	Do.
8020	2****	do	Bright yellow	51,800	95,000	22.0	44.6	Do.
8021	3	do	White heat	44,000	103,120	15.3	30.6	Granular; silky center.
8022	6*	High forging	Not reheated	55,000	106,000	18.3	39.2	Silky, in part granular.
8023	6**	do	Blood red	54,000	106,080	17.0	33.5	Granular; silky spot at circumference.
8024	6***	do	Low cherry	54,000	106,400	17.7	33.5	Do.
8025	7*	do	Full cherry	50,000	92,000	23.3	52.2	Fine, silky.
8026	7**	do	Low yellow	62,400	96,400	21.0	30.6	Do.
8027	7***	do	Bright yellow	53,000	96,000	21.3	44.6	Do.
8028	8*	do	White heat	44,000	97,200	16.3	33.5	Granular; silky center.
8029	11*	Low forging		48,000	98,560	20.7	41.9	Silky.
8030	11**	do	Blood red	48,000	95,760	20.3	44.6	Do.
8031	11***	do	Low cherry	48,000	94,120	23.3	44.6	Do.
8032	12*	do	Full cherry	46,000	97,200	22.0	44.6	Do.
8033	12**	do	Low yellow	56,200	92,480	25.0	49.7	Do.
8034	12***	do	Full yellow	51,000	93,360	20.3	44.6	Fine, silky
8035	16*	High forging		50,000	107,200	15.3	36.4	Granular; silky center.
8036	16**	do	Blood red	52,000	108,400	17.3	33.5	Granular, 60 per cent; silky, 40 per cent.
8037	16***	do	Low cherry	50,000	105,200	16.3	27.6	Granular; silky spot at circumference.
8038	17*	do	Full cherry	40,000	89,680	18.3	44.6	Granular, 50 per cent; silky, 50 per cent.
8039	17**	do	Low yellow	57,000	92,000	23.7	47.2	Fine, silky.
8040	17***	do	Bright yellow	55,200	91,520	23.7	47.2	Do.
8042	3**	Low forging	Not reheated	53,000	94,560	20.3	41.9	Do.
8043	4****	do	do	56,800	94,000	24.3	47.2	Do.
				Pounds.	*Pounds.*	*Per cent.*	*Per cent*	
8044	8**	High forging	Not reheated	50,200	95,200	20.0	44.6	Silky, and granular
8045	9****	do	do	49,000	94,000	20.0	47.2	Fine, silky
8046	13**	Low forging		47,000	97,200	20.0	44.6	Do.
8047	14***	do		45,000	94,960	19.7	39.2	Do.
8048	17****	High forging		44,000	96,800	19.3	36.4	Granular, 60 per cent; silky center, 40 per cent
8049	19***	do		48,000	101,460	18.0	36.4	Granular, 50 per cent; silky center, 50 per cent

TABULATION OF TENSILE SPECIMENS FROM 62 IN. CARBON STEEL INGOT.

tests were made, and it was shown that tensile properties characteristic of the earlier over-straining loads still remain in the iron at the present time.

The inquiry of previous years into the properties of cements, mortars, and concretes was continued and extended to the tests of columns 1 ft. square in cross section by 8 ft. in height. Other tests related to brick piers, wooden posts, etc. Tests on the endurance of steel bars to repeated alternate stresses were continued. In the present testing apparatus the maximum fibre stresses are applied at the rate of 500 times per minute. Means are being provided for subjecting the experimental shafts to very rapid alternations of

stresses. A steam turbine having a normal rated speed of 38,000 rotations per minute will be used for the purpose. Appended are details of some of the tests included in the report.

WHEELS AND AXLE OF A 75-MILLIMETRE MOUNTAIN-GUN CARRIAGE.

The wheels were loaded by pressure applied at their rims, acting in an inward direction. The reduction in the gauge of the wheels was determined under successively increased loads, and the deflection of the axle observed at the middle of its length, as shown by the accompanying photograph. After the test the condition of the wheels is shown by the second photograph on page 990.

Applied loads.	Reduction in gauge.	Deflection of axle.	Remarks
Pounds.	*Inches.*	*Inch.*	
300	0.	0.	Initial load.
400	.07	.003	
500	.14	.005	
600	20	.007	
700	.28	.010	
800	.37	.012	
900	.47	.014	
1,000	.53	.017	
1,100	62	.019	
1,200	.72	022	
1,300	.81	025	Rested one-half hour.
1,400	.91	.028	
1,500	1 00	030	
1,600	1.10	032	
1,700	1 20	035	
1,800	1.30	.037	
1,900	1 42	039	
2,000	1.53	041	
2,100	1 65	.045	
2,200	1 78	047	
2,300	1 93	050	
2,400	2 05	052	
2,500	2 20	054	
2,600	2 36	057	
2,700	2.57	060	Spokes disturbed at hub.
2.800	2.77	063	
4,100	....	....	Ultimate strength.

TEST OF WHEELS AND AXLE FOR 75-MILLIMETRE MOUNTAIN GUN CARRIAGE.

Fractured two spokes at the hub and one spoke at tenon at the felloe. Bent the inner flange of the hub. Axle permanently deflected along the middle of its length. Hubs worked f eely on journals after the test.

New wheels were placed on the axle after the test, and their gauge measured at bottom 2 ft. 2½ in., as against 2 ft. 3⅜ in., the gauge of a new finished axle, showing a difference of ⅞ in.

The deflection of the axle was such that the gauge of the wheels was a minimum on the front quarter.

TESTS ON 62-IN. CARBON STEEL INGOT.

The chemical composition of the steel which formed the subject of the tests summarised on the opposite page, was as follows :—

Carbon..	·58
Manganese	·73
Silicon	·20
Phosphorus	·028
Sulphur	·023

The specimens were square bars drawn down under the hammer at different temperatures, cooled in sand, subsequently reheated, and finally cooled in sand.

The specimens were of ·564 in. diameter by 3 in. length of stem.

Specimens 8,029 to 8,040 inclusive, and numbers 8,046 to 8,049 inclusive, were reheated immediately after forging to the original forging temperatures and then cooled in sand. Numbers 8,030 to 8,034 and 8,036 to 8,040 inclusive were again heated as shown and finally cooled in sand.

SHRAPNEL CASES.

The shrapnel cases described were received from Frankford Arsenal, and were made by the Bethlehem Steel Company. The following details are given of the first case :—

TEST BY INTERIOR HYDROSTATIC PRESSURE.

Exterior diameter of case turned to 2 in. ·92.

Interior diameter of case bored to 2 in. ·715 for a length of 5 in.

Case entered testing cylinder 1 in., leaving 4 in. length of reduced thickness of walls exposed to the interior pressures of the test.

Sectional area of piston, 5·79 square inches.

Case ruptured longitudinally, beginning at a point in the exterior surface near the middle of the length of the section of reduced thickness. The line of rupture extended in one direction to the end of the case, in the opposite direction to the end of the reduced part, where the line of fracture bifurcated, curving to circumferential planes.

Applied loads.			Exterior diameter of case.	Remarks.
Load on piston.	Interior pressure per square inch.	Fiber stress on case per square inch.		
Pounds.	*Pounds.*	*Pounds.*	*Inches.*	
0	0	0	2.92	
24,000	4,145	58,124	2.94	
30,000	5,181	... ..	2.95	
35,000	6,045	.. ..	2.97	
40,000	6,908	... ..	2.99	
43,000	7,426	..	3.00	
46,000	7,945	111,986	3.04	Rapid expansion.
50,000	8,636	... ..	3.07	
52,600	9,085	125,054	....	Ultimate strength.

SHRAPNEL CASE TESTS.

Appearance of fracture, granular.

Length of circumference after rupture, maximum 10 in. ·40.

Circumferential extension, 1 in. ·23 = 13·4 per cent.

3-IN. SHRAPNEL CASE.

Case No. [illegible] after rupture, and strip for bending test.

WARSHIP ENGINEERING.

WE have received a very interesting reprint from the 1905–6 edition of "Fighting Ships,"* a work which has now reached the eighth year of issue, and appears to fulfil an ever-increasing sphere of usefulness. It is entitled "Warship Engineering," by Charles de Grave Sells, M.Inst.C.E., and leads off with an article on propelling machinery, in which turbine progress is naturally prominent. As to the present position of the turbine, the author says :—

"There is no doubt that the advantage of steam turbines over reciprocating engines increases with the size of the installation, and for a vessel requiring only 1,000 h.p., it is certain that no one would think of installing a turbine engine under existing conditions : but for a vessel of 15,000 h.p., especially if continuous running at high speed is required, steam turbines do seem to present undoubted advantages over the old type of engine.

TURBINE LIMITS.

"For war vessels there is now a pretty clearly defined limit below which it is neither advantageous nor economical to go, and the practical results now obtained show that in torpedo boats having a speed of from 24 to 26 knots, and from 2,000 to 3,000 h.p., the turbine would not give as good a result as reciprocating engines to the extent of at least a knot in speed ; whilst when the vessel was running at 12 to 14 knots the consumption would probably be double what it would be with reciprocating engines, even if a cruising turbine was fitted.

AIR-PUMPING PLANT.

Mr. de Grave Sells goes on to point out the great effect which the advent of the steam turbine has had on the air-pumping plant.

"A high vacuum is absolutely necessary to obtain its fullest efficiency, and it was found

* "Fighting Ships." Founded and edited by Fred T. Jane. Sampson Low, Marston and Co. Ltd.

that sufficiently satisfactory results were not obtainable with the pumps as usually fitted. The British cruiser, *Amethyst*, was originally fitted with combined air and circulating pumps, but these were eventually replaced by Messrs. Weir's twin air pumps, which resulted in a much better vacuum being obtained. This firm has furnished the air-pumping plant for most of the turbine ships, and in their type the condensed water from the condenser is dealt with by an independent air pump of their usual type, having foot, bucket, and head valve as usual, and driven by one or two steam cylinders, according to the size of the installation, the pump rods being connected by a rocking beam. On the suction side of this pump a large air vessel is fitted, and from the top of this air vessel a connection is made to a dry air pump on the top of the centrifugal pump engine, and driven by prolonging the rod of this engine ; or, in some cases the dry air pump is driven by a small high-speed independent engine, and disassociated from the centrifugal pump altogether. The effect of this arrangement is that the independent air pumps are made much smaller than if they had to deal with the entire volume of air and water, as the dry-air pump, drawing from the top of the air vessel, takes off the greater portion of the air, and thus leaves the independent air pump to deal almost entirely with the water, the result being the attainment of a very high vacuum. On a trial of one of these plants fitted for a set of turbine engines 97·8 per cent. of vacuum with corrected barometer was obtained, and a similar percentage is now generally looked for with these plants."

There are many readable pages on the subject of steam generators, and *inter alia* an account is given of the boiler invented by Engineer Admiral Miyabara, and largely adopted in the Japanese Navy.

ELECTRIC PLANT ON WARSHIPS

Another subject which receives a good deal of attention is oil fuel, and prominence is given to the increase of electric generating plant in British and other warships. "It is in the United States," says the author, "that electricity still finds its greatest development for use on warships, and with the great experience had there with the advantages of its use, it has been decided to adopt it still more largely on board the 16,000-ton battleships and on the two 14,500-ton armoured cruisers, for which tenders were received the commencement of this year. In the battleship *New Hampshire* there is to be electrical control for the four 12-in. guns, and their ammunition hoists are to be operated by electric power. For the supply of ammunition to the smaller guns there are to be twelve 7-in. and fourteen 3-in. hoists, driven at constant speed by electric motors, as well as four horizontal ammunition conveyors operated by electric motors. Amongst other uses on board, electricity is to be used for all the tools in the engineers' workshops and for a kneading machine and a dish-washing machine. The electric plant consists of no less than eight dynamos placed in two independent dynamo rooms, and six motor generators for power supply to the turret-turning motors. There are to be ten portable ¼ h.p. ventilating sets, fifty $\frac{1}{12}$-h.p., and twelve ⅛-h.p. bracket fans.

AN AMERICAN EQUIPMENT.

The electric plant on board the armoured cruiser *Colorado*, which has recently finished her trials, is given as a good example of modern United States naval practice in this respect, the auxiliary machinery operated by electricity being as follows :—

[illegible]	[illegible]
4 rammers ..	[illegible]
10 deck hoists and cranes ..	[illegible]
[illegible]	[illegible]

[illegible] electric

IRON ORE DEPOSITS ABROAD.

POSSIBLE FIELDS FOR FUTURE ENTERPRISE.

(*Continued from page 658.*)

UNITED STATES (CHARLESTON DISTRICT).

Mr. Consul de Coetlogon reports that iron ore is somewhat widely distributed in the western counties of North and South Carolina, Georgia, and also in the eastern parts of the State of Tennessee.

Tennessee is the most important State in this consular district producing iron and coal. In the Georgian iron district, near Altoona, situated between Chattanooga and Atlanta, iron ore is mined and forwarded from there to the blast furnaces in Tennessee and Alabama for treatment of the ore, there being no blasting facilities in operation at present in Georgia, South Carolina, and North Carolina.

The principal iron mine in North Carolina is situated at Cranberry, in Mitchell County, at the terminus of the Tennessee and Western North Carolina Railroad. The ore body consists of an immense lens of magnetite. The ore is in irregular masses through the gangue, and is at times intimately associated with it in bands, the extent and thickness of which are variable, ranging from a few inches to more than 50 ft.

The only other mine producing iron in North Carolina in 1901 was the Potato Creek Mine, situated in the Piney Creek District, of Alleghany County, and it contains magnetic ore. There are also large iron deposits in Ashe County, North Carolina.

Some of the principal other iron localities of North Carolina for magnetite ores are in Granville, Stokes, Surry, Catawba, Ashe, and Mitchell Counties; while the limonite ores are in Chatham, Gaston, and Cherokee Counties. Geologically speaking, the magnetite and hæmatite ores are confined almost exclusively to the crystalline rocks. Some limonites are also found in these rocks and in the Ocoee formation of Madison and Cherokee Counties. The history of iron mining in North Carolina dates back to the year 1729, when small shipments of the ore were made to England, mined most likely from the bog ores near the coast.

Tennessee is the most important iron producing State in this consular district, as before mentioned; there are twenty-two blast furnaces in the State, and the production of pig iron during the year 1901 was 337,139 tons, compared with 267,825 tons in 1890.

The amount of iron ore produced in 1900 was 594,171 [illegible] tons in [illegible].

TENNESSEE VARIETIES OF IRON.

There are three varieties of iron ore found in the Tennessee iron districts, viz., brown ore, or limonite, red fossil ore, and the carbonate of iron. The brown ore is found in a belt fifty miles wide, west of Nashville, and extending from the Ohio river southwards through Dickson, Hickman, and Wayne Counties, in the State of Tennessee, to Russelville in Alabama.

This ore is found in pockets, or banks, some of which are extensive and others small. The best deposits of this ore, however, so far as has been ascertained, are contiguous to the Cumberland and Mannie furnaces. The distribution of the deposit includes the Nunnelly Banks in Hickman County, together with the Mannie Banks and Wayne Banks in Wayne County.

When properly dressed these ores will average about 50 per cent. in metallic iron, about 8 per cent. in siliceous matter, and a variable quantity of phosphorus, ranging from a quarter per cent. to one per cent.; there being scarcely a trace of sulphur in any of them. It is probable that the deposits near Mannie furnace and southwards through Wayne County contain as much iron ore within a limited area as any other deposits of brown ore in the south. As much as twenty thousand tons has been mined from a single acre.

The red fossil ore is found on the eastern side of Sequatchie Valley, Tennessee, at the foot of Walden's Bridge; this ore has been mined for many years at Inman, and used in the South Pittsburg furnaces. While there appears to be an abundant quantity, the ore is low in metallic iron and very high in the carbonate of lime.

The carbonate of iron called the spathic, or black band iron ore, occurs in a stratified deposit in contact with the mountain, or Bangor limestone, forming usually a layer between that and the lower conglomerate rock. This bed of ore has been met with on Crow Creek in Franklin County, in the borings at Tracey City, and also at Beersheba Springs. It is $3\frac{1}{2}$ ft. thick at the head of Hubbard's Cove, in the north-western part of Grundy County, its characteristics being lightness of colour, fineness of grain, and a certain resemblance to an earth coloured limestone.

This ore is undergoing, at all exposed points, a change from the carbonate to the limonite, or the oxide of iron.

An analysis of this ore has been made by the Hon. Charles W. Hayes, United States Geologist, No. 1 being the unchanged carbonate, and No. 2 the oxydised carbonate :—

	No. 1.	No. 2.
Metallic iron	35·10	47·2[illegible]
Silica	5·55	8·[illegible]
Carbonic acid	34·29	—
Phosphorus	·14	·20

The above shows that this ore compares favourably with other carbonates of iron found elsewhere, and that it would give good results in a furnace after roasting.

THE TRANSPORT PROBLEM.

The nearest shipping ports to the iron ore sections in this district, as above described, capable of admitting ocean steamers, are Savannah and Brunswick, in Georgia, Port Royal and Charleston in South Carolina and Wilmington in North Carolina ; each of these ports is about four hundred miles from the ore deposits.

The only means of transporting the ore to the shipping ports would be by railway, and the last quoted railway rates were ten to twelve shillings per ton, equal in United States currency to about two and a half to three dollars per ton.

Negro labour is perhaps the principal kind, the cheapest and most available for mining purposes, all things considered, in this part of the country ; it is worth from a dollar to a dollar and a half per day. It might also be possible to obtain convict labour,at a cheaper rate from the State in Georgia, Tennessee, and North Carolina, by making special contracts with the authorities for the same, rates perhaps depending to some extent on the number of hands wanted and period required.

The status of the proprietors of the ore lands varies greatly, some being rich and quite independent, but many holders are persons of moderate means, who would be willing to sell on reasonable terms. Much of the undeveloped ore land could be bought cheaply by careful purchasers, who, watching their opportunities and taking advantage of forced sales, could at times secure good bargains.

Most of the leading real estate dealers in the towns of Atlanta, Georgia, Knoxville and Chattanooga, in Tennessee, and Asheville, in North Carolina, could put prospective buyers into communication with sellers of ore lands in their respective localities.

The deposits of iron ore in all the States of this district have been at some time worked, but the product of the Tennessee, North Carolina, and Georgia mines are used to meet local demands of the domestic American markets, practically none of it having been shipped abroad during the past five years, whilst foreign shipments of iron from Charleston (South Carolina) also from Savannah (Georgia) during this period have originated in nearly every case at Brimingham, Alabama.

There are no especial obstacles in the way of successful mining in this district, except the competition of the important iron manufacturing establishments around Birmingham, Alabama, and the other American competitors in Pennsylvania and elsewhere.

NEW ORLEANS.

A report by Mr. Consul Vansittart, states : Extensive beds of iron ore are to be found throughout the mineral region of Alabama, in such proximity to coal, limestone, and dolomite, that its manufacture is much cheaper than in other mineral regions of America, where these materials have to be assembled at greater cost.

The brown ore is found in pockets, and for that reason it is hard to estimate with any certainty the extent of the same. It is being mined extensively in eight counties, viz. : Cherokee, Etowah, Calhoun, Talladega, Blount, Shelby, Bibb, and Jefferson. These deposits are said to exist in a number of other counties, in which there has been no mining done up to the present time.

The principal ore supply is from the red ores, found outcropping on Red Mountain. This vein runs along this mountain for a distance of 150 miles, reaching in some places a thickness of 26 ft. There has been no deterioration in the quality of this ore, although some of the slopes have been driven down as far as 2,000 ft. The supply, therefore, might be considered practically inexhaustible.

The number of men employed in and about the ore mines is about five thousand.

The production of ore in the State, ninety per cent. of which is in the Birmingham district, was :—

[illegible]	[illegible] tons
„ 1885	505,000 „
[illegible]	1,897,815 „
[illegible]	2,199,390 „
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	2,881,593 „

[illegible] from the [illegible] a thing [illegible] probably be about 75 cents per ton.

A COMBINED AIR PUMP CONDENSER AND DELIVERY BOX (BENN'S PATENT).

BY MESSRS. S. S. STOTT AND CO., HASLINGDEN.

WE illustrate herewith a simple and compact type of combined air-pump and condenser specially designed for use in connection with factory and other engines, where, as a rule, a large quantity of water has to be dealt with. To the makers, Messrs. S. S. Stott and Co., of Haslingden, near Manchester, we are indebted for the following particulars :—

As will be gathered from figs. 1, 2 and 3, the air-pump is vertical, the pump-bucket working in a barrel, which is formed by a continuation of the walls of the condenser. The pump-bucket casting contains no valves, and there is also nothing in the nature of foot-valves, the only valves in the pump being the delivery valves preventing the return of the water from the hot well. These consist of rubber flaps, held by their upper edges, and resting, when closed, against grids. They are held entirely without the use of bolts or screws, being registered for position by dowels cast on their seatings.

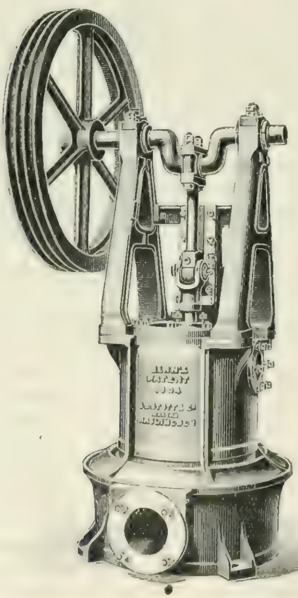


FIG. 1. COMBINED AIR PUMP CONDENSER AND DELIVERY BOX.

The cast-iron guards, which form backings for the rubber valves also hold the latter to their work, being themselves secured by their ends, which fit into V-shaped recesses provided for the purpose. Any valve may therefore be removed, if required, merely by lifting the guard plate out of its pockets, for which operation no tools are required.

The hot well is an annular space formed round the air-pump barrel, and is fitted with a light cast-iron cover over each valve. These covers may be lifted out for inspection of the interior, and merely serve to prevent water splashing over the sides of the hot well when the pump is delivering large quantities of air.

The very large valve area permitted by the arrangement, and the fewness of the parts will be appreciated upon a study of the design. The most noticeable features of the pump are the shape of the bucket and the method by which foot valves between the condenser and the pump barrel are eliminated. The bucket at the upper end of its stroke emerges altogether from the barrel proper, it being then guided by a number of bored faces supported from the walls of the condenser and forming extensions of the barrel.

When the bucket is in this position there is free communication between the condenser and the pump barrel, and all water will at once run down into the latter, being assisted in its progress by the curvature given to the condenser shell at this part. The condenser is thus effectively drained at every stroke. The descent of the bucket first shuts off communication between the condenser and pump, and then drives out the trapped water through the delivery valves into the hot well.

Owing to the shape of the underside of the bucket, the air and vapour in the hollow part of the cone acts as a cushion to the blow ; but it is very evident that unless this vapour is expelled before the return

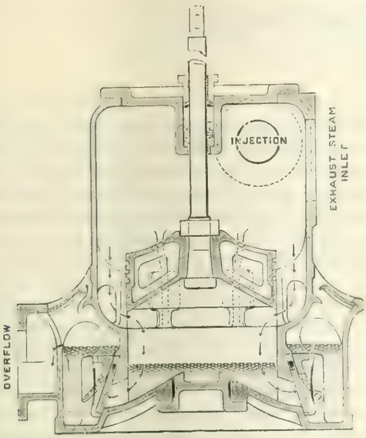


FIG. 2. SECTION OF COMBINED CONDENSER AND AIR PUMP.

of the bucket, its expansion would seriously interfere with the volumetric efficiency of the pump. The method of attachment of the bucket to the rod consists as will be seen by fig. 1, of cottering the bucket on a parallel enlargement to the rod, tightly against a cylindrical head. Under no circumstances can the bucket drop off the rod, though it may be removed easily when necessary. The cylindrical head of the rod descends into a recess cast for it in the bottom cover of the pump. This recess becomes filled with water when the bucket is at the top of its stroke, and when the bucket approaches its lowest position the water is forced out by the end of the rod, and sweeps out all air and vapour from beneath the bucket.

The indicator diagram shown in fig. 3 was taken from the underside of the bucket of an air-pump of the type in question, and illustrates the small amount of work expended in maintaining a vacuum of 27 in. in the condenser of a certain compound engine. The sudden drop of pressure on the commencement of the up-stroke of the bucket shows how effectively the air from beneath the bucket has been expelled. The particulars of the test are as follows :—

Particulars of the Air-pump Test, June 29th, 1905.

Horizontal tandem engine, with 8-in. high-pressure cylinder, 14-in. low-pressure cylinder, 24-in. stroke, 110 revolutions.

Air-pump, 12 in. in diameter, 6-in. effective stroke, 8-in. working stroke, 110 revolutions.

Temperature of engine-house, 82 deg.

Temperature of injection water, 80 deg.

Temperature of overflow water, 104 deg.

Vacuum by mercury gauge, 27 in.

Vacuum by absolute gauge, $2\frac{3}{8}$ in.

Capacity of water tank, 71 gallons.

Time taken in filling tank, 1 min. 16 sec.

Height of air-pump above sea level, 710 ft.

The mercury gauge is by Casartelli, Manchester.

The absolute mercury gauge is by the Cambridge Scientific Instrument Company, Cambridge.

NOTE.—The valves in connection with cylinders are of the **D** slide type, and have been working some twelve or fourteen years without repairs. The clearance in the high pressure cylinder is assumed as from [illegible] to 10 per cent. of the cylinder capacity.

Three separate Richards indicators were used, one for each cylinder, and one for the air pump, and every care was taken to maintain the load steady and to ensure the accuracy of the various readings.

The engine at the time of the test was indicating 31 indicated horse-power.

A small pipe as a by-pass connecting the condenser with the underside of the bucket is fitted with a cock, which is open when the engine is started, and afterwards closed by hand. The object is to release the load on the pump which would occur were there no vacuum in the condenser. The combined condenser and air-pump is made, under "Benn's" patent, by the makers, who build the apparatus in various sizes and types, either driven directly from the engine or independently by motor belting, or ropes. It is being introduced with much success in connection with electric lighting and factory engines. Specially designed pumps of this type are also at work exhausting acids and vapours in chemical works. When used in conjunction with surface condensers, the condensing chamber is reduced in height, and acts as a receiver, the pump and valves remaining as before.

It may be added that these pumps are now working on beam engines up to 850 h.p., taking their motion direct from the engine beam, which gives a stroke to the pump of [illegible] in., and to the [illegible] a speed of [illegible] per minute without any knocking.

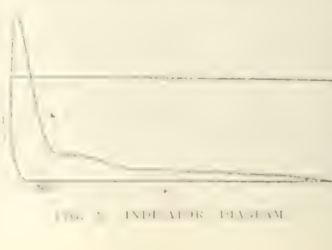


FIG. 3. INDICATOR DIAGRAM.

ROLLER BEARINGS.

By C. C.

SINCE the electric motor has come into general use the question of the economical transmission of power has come more prominently before manufacturers, and the more up-to-date concerns have been quick to appreciate the possibility of effecting large economies by eliminating the large amount of frictional load which always exists with long heavy lines of shafting.

The electric motor does away with the necessity of a great deal of shafting, especially the heavy main lines. At the same time, there are many cases where it is more economical to employ various lines of shafting, each separately driven by an electric motor, than to have each and every machine especially equipped with a motor of its own. When a manufacturer can stand in front of an electrical instrument and observe as easily as he tells the time of day from his watch just exactly how much power he is wasting and absolutely throwing away on the friction on his line shafting, he is very apt to welcome any suggestion that will tend to materially reduce this friction.

Solid rollers have been used for many years off and on, but these bearings, like ball bearings, in order to be thoroughly durable, must be very nicely made hardened, and ground throughout, which, of course, means expense, and they also require sleeves on the shaft, which means a lot of labour and trouble in fixing. Expense again stands in the way of the general adoption of these bearings for general line shafting transmission. There are, of course, cheaper grades of solid roller bearings, but what appears to be wanting is a roller that is flexible and will give to a certain degree to the various inner qualities which are bound to exist in ordinary bearing surfaces.

In the writer's experience, the only bearing which answers to this description is the Hyatt flexible roller. This roller was invented by John W. Hyatt, who also invented celluloid, which is known the world over. Mr. Hyatt experimented a number of years before he determined on the proper method of making a roller for machinery bearings, which possessed the necessary degree of flexibility in order to make it durable and highly efficient. The Hyatt roller is practically a helical spring, being wound from a ribbon of steel into this shape. The diameter of the roller and the size of the steel from which it is made, are all varied according to the speed and load under which the roller is to operate. They are not put through a hardening process, but are constructed of a grade of steel especially made for the purpose, which is hard and very tough. The rollers are wound in a special machine constructed for the purpose, and within very fine limits of absolute size. The fact that they are flexible and elastic makes it possible to operate them on the ordinary soft-steel shafting which is in general use, without wearing either the shafting or the rollers to any appreciable degree. The rollers are held in position round the shaft in a brass or steel cage of the simplest construction, with bars at proper intervals to keep the rollers practically parallel with the shaft. If, however, a roller is permitted to get very slightly out of line it does not do any damage, either to itself or to the shafting, due to the fact that it is flexible; whereas in the case of a solid roller, if it becomes the least bit out of parallel with the shaft, it immediately begins to wear heavily on the ends and is likely to slip. This kind of thing very soon renders a solid roller bearing useless.

Regarding the efficiency of roller bearings, especially of the latter class described, it is reported that in a plant which was operated by a gas engine, a saving of 21½ per cent. of the gas was effected by substituting flexible roller bearings in the place of the ordinary type. In another instance by doing the same thing, 17½ per cent. of the coal was saved. The heavier the shafting the greater the saving appears to be in proportion.

The two great obstacles which have stood in the way for many years, of the general adoption of roller bearings in mills, for shafting, etc., have been the excessive cost and unreliability of such bearings, that is, unless special sleeves were provided for the shafting it was found that the hard rollers would ruin the shafting in a very short time. Both these objections have been overcome by the spiral flexible roller, inasmuch as it is comparatively cheap and does not require a hard sleeve on the shafting to prevent it cutting the same.

The reduction of the cost of operating a plant is a subject which should be of great interest to all manufacturers, and it would seem that it would be quite worth their while to investigate the properties of the various bearings on the market at the present time, which are designed to accomplish this saving.

SHIPBUILDING NOTES.

An interesting launch took place from the Woolston yard of Messrs. John I. Thornycroft and Co.'s Southampton works on Saturday last, the vessel being the *Branwen*, the first steam yacht constructed at these works. Built for Lord Howard de Walden to Lloyd's highest class, she is of the following dimensions: Length overall, 135 ft.; between perpendiculars, 111 ft. 6 in.; on load water line, 108 ft.; breadth moulded, 16 ft. 6 in.; depth, 11 ft. 3 in. The yacht is of steel, with handsome scroll figurehead and trail board, quarter badges, etc.; the design being oak leaves and acorns in relief, and embodying the owner's armorial bearings. She is rigged as a fore and aft schooner, with two pole masts; the machinery is situated amidships, and consists of a triple-expansion condensing engine, having cylinders 9 in., 15 in., and 25 in. diameter, with a stroke of 18 in., and a cylindrical multitubular return tube boiler, 9 ft. 7 in. inside diameter, by 8 ft. 9 in. long, constructed for a working pressure of 180 lb. per square inch. The yacht will be heated throughout by steam, with radiators in the principal cabins. Two boats are to be carried in davits, a 20-ft. gig, and a 16-ft. cutter. Occasionally a 14-ft. motor launch will be carried in place of the cutter. A steam capstan for working the cables and warping the yacht is fitted forward.

The Fairfield Shipbuilding and Engineering Company, Ltd., are constructing two twin-screw steamers for the Canadian Pacific Railway Company. They are to be named *Empress of Britain* and *Empress of Ireland*, and are expected to be in commission early next summer. Each vessel will be of 14,500 tons; length, 550 ft.; and a 64-ft. beam. Their twin engines, of the balanced reciprocating type will be capable of sustaining a speed of [illegible] knots. The design and equipment of the steamers render them equally serviceable for the passenger service on the Atlantic, or with the company's existing fleet on the Pacific.

On Tuesday, the 24th ult., the new steel screw steamer *Oberhausen* sailed from the Tyne after a successful trial trip. The vessel was built by Swan, Hunter and Wigham Richardson, Ltd., for the Deutsche-Australische D.G., of Hamburg She is 386 ft. in length, by 50 ft. beam, and has been built to attain the highest class in Lloyd's Register. The engines and boilers have also been constructed by Swan, Hunter, and Wigham Richardson, Ltd., the former are of the quadruple-expansion type on four cranks on the Yarrow Schlick and Tweedy system. On the trial trip the vessel attained the speed of 12¾ knots per hour.

The large steel screw steamer *Zafra*, built by Messrs R. Craggs and Sons, Ltd., Tees Dockyard, Middlesbrough, for the English and American Shipping Company Ltd. (managers, C. T. Bowring and Co., London), proceeded to sea for her official trials on the 18th inst., the vessel registering an average speed of 11¾ knots over a ten-knot course. The cargo arrangements include six powerful steam winches, large marine type donkey boiler working at 90 lb. pressure, and double derricks are fitted throughout. Messrs. Emerson, Walker and Thompson Bros., quick warping steam windlass is provided, and powerful steam-steering gear amidships. The water ballast arrangements which provide for about 1,275 tons has received special attention. The machinery was fitted by the North-Eastern Marine Engineering Company, Ltd., of Sunderland, having cylinders 25 in., 42 in., 68 in. by 45 in. stroke, steam being supplied by two large single-ended boilers working at 180 lb. pressure to the square inch.

Messrs. R. Craggs and Sons, Ltd., recently launched from their Tees Dockyard, Middlesbrough, a steel [illegible] ft. long, [illegible] ft. [illegible] in. beam, 25 ft. 6 in. depth moulded. The vessel is being built under special survey to take the highest class under Lloyd's three-deck rule with one deck laid, having poop, bridge, and forecastle. Cellular double bottom is fitted throughout for water ballast which is also carried in extra large after peak tank. Powerful steam winches are provided, driven from a specially large marine type donkey boiler. Hastie's steam-steering gear is supplied, and improved quick warping steam windlass is fitted forward. The machinery will be fitted by Messrs. Blair and Co., Ltd., of Stockton-on-Tees, having cylinders 25 in., 41 in., 67 in., by 45 in. stroke steam being supplied by two [illegible] at a pressure of [illegible] The vessel has been designed to afford a large cubic capacity and is [illegible] ft. [illegible] in. draft [illegible] built to the order of Messrs. W. H. [illegible] the ways [illegible]

OPENINGS FOR TRADE ABROAD.

Brazil.

Tenders will be opened on December 16th, at the offices of the Municipality, Sao Luiz, Maranhao, Brazil, for the installation of an electric lighting system in that town.

India.

The Times of India, in reporting the establishment of a motor service in Assam, between Gauhati and Shillong, subsidised by the Government, remarks that motor cars may increase considerably in numbers in that district.

Egypt.

There is an increasing demand in Egypt for agricultural machinery, both steam and motor-driven. Two distinct kinds of machines are in request; the large cultivator wants a powerful and solid steam plough, and the small cultivator a light motor plough.

Belgium.

Tenders will shortly be invited at the Bourse de Commerce, Brussels, for the supply, in one lot, of ten weigh-bridges for wagons of 15 tons capacity. The weigh-bridges must be delivered within twenty weeks from the date of announcement of the result of the adjudication. Particulars from M. de Rudder, 11, rue de Louvain, Brussels.

Chile.

Tenders are in demand for the construction in Chile of a floating steel dock to raise vessels of 1,000 tons displacement, and to be installed in the naval dockyard of Talcahuano. Tenders must be sent in by May 1st, 1906, to the "Direccion del Material," Valparaiso, where full information may be obtained. They must be accompanied by a deposit of about £2,333.

Prussia.

The Diet have at last sanctioned the Prussian Canal Bill, which provides for the construction of a waterway connecting the Rhine and the Weser with a branch canal to Hanover. The Bill also authorises the construction of a waterway from Berlin to Stettin for vessels of 600 tons, and two minor schemes for the improvement of the waterways connecting the Oder and the Vistula rivers. The total cost is estimated at £16,728,750, of which £12,537,500 are for the Rhine-Weser Canal, and £2,650,000 for the Berlin-Stettin waterway.

South Africa.

The Canadian Commercial Agent at Cape Town states that owing to the long periodical droughts and the general uncertainty of rain falling in many districts, deep boring to establish a supply of water when needed is considerably on the increase. Such being the case, adds the agent, the demand for all appliances for this purpose will greatly increase in the future.

A recent issue of the Orange River Colony Government Gazette contains the text of an Ordinance authorising the construction, by the Government of Natal, of a railway between the towns of Bethlehem and Kroonstad, and the working thereof, and of the railway line between Van Reenen and Bethlehem.

Bulgaria.

On the 13th inst., tenders will be opened at the offices of the Administrator of Finances, Sofia, for the supply of 3 first-class carriages, 10 first and second-class carriages, 20 third-class carriages, 10 mail vans, 20 luggage vans, and 400 goods wagons of fifteen tons capacity (closed), and 150 two axled goods wagons of the same capacity (open). The estimated cost of the goods to be tendered for is about £108,000. Specifications and plans may be obtained from the above address. The Bulgarian Ministry of Public Works proposes to ask for authorisation for a scheme of local railways, quays in the riverside towns of the Danube, docks at Varna and Bourgas, and port works at Baltchik. In addition, the Government will in 1906 invite tenders for the construction of the remainder of the Trans-Balkan line.

Netherlands.

The Commercial Intelligence Branch of the Board of Trade have been notified by H.M. consul at Amsterdam that on the 8th inst. the "Tramweg-Maatschappij Eindhoven Geldrop," of Stationsplein, Eindhoven, will be prepared to receive tenders for:—Contract No. 8.—The construction of the substructure of a swivel-bridge over the Zuid-Willemsvaart at Helmond. Contract No. 9.—The construction of the iron superstructure of a swivel-bridge over the Zuid-Willemsvaart at Helmond. Contract No. 10.—The construction of the substructure of two fixed bridges over the river "de Aa" at Helmond. Contract No. 11.—The construction of the iron superstructure of a bridge for ordinary traffic, and of a railway-bridge over the River "de Aa" at Helmond. Copies of the contracts, with drawings, may be obtained at the office of the Tramway Company "De Meijerij," at Eindhoven.

CONTRACTORS' NEWS.

We shall be pleased to insert under this column, free of charge, particulars of open contracts.

CONTRACTS OPEN.

Last Day.

Great Yarmouth.—The following, for the Guardians: (Contract No. 1) two steel Lancashire boilers; (3) one shallow well. Mr. W. J. Carpenter, A.M.Inst.E., South Denes Road, Great Yarmouth ... .. Nov. 4

Clacton-on-Sea.—Supply and erection of the following, for the Clacton-on-Sea Urban District Council: (Section A) gas engines and dynamos; (B) switchboard; (C) underground mains; (D) accumulators; (E) meters; (F) crane; (G) buildings. Mr. W. H. Trentham, 39, Victoria Street, Westminster, S.W.... .. ... Nov. 6

Edinburgh. — Installation of intercommunication telephone system throughout the offices, Castle Terrace, Edinburgh, for the Edinburgh Parish Council. Mr. R. M. Cameron, architect, 53, Great King Street, Edinburgh ... ... Nov 7

London.—Supply of about 394 tons of steel bridge girders and other iron and steel work of British manufacture, for the Great Western Railway Company. Engineer, Paddington Station ... ... Nov. 7

Gorton.—Supply of 20 new carriages, for the Cheshire Lines Committee. Mr. J. G. Robinson, carriage and wagon superintendent, Great Central Railway Works, Gorton ... ... Nov. 7

Manchester.—Supply of (a) tramcar trucks; (b) electrical equipments for cars, for the tramways committee. Mr. J. M. M'Elroy, General Manager, Tramways Department, 55, Piccadilly, Manchester... ... ... Nov. 11

Coventry. — Supply and erection at their Foleshill works of six purifiers, each 30 ft. wide by 6 ft. deep, four of the purifiers to be 50 ft. long and two to be 60 ft. long each, with 24-in. diameter valves and connections, for the Gas Committee. Mr. Fletcher W. Stevenson, engineer and general manager, Gasworks, Coventry ... ... Nov. [illegible]

Barrow-in-Furness.—Supply and erection of (Section A) one 500-k.w. combined steam engine and generator; (B) one balancer booster; (C) switchboard panels and connections for generator and booster; (D) one water-tube boiler with superheater; (E) one mechanical stoker; (F) steam and exhaust pipes, valves, etc.; (G) one economiser; (H) ironwork; (I) one 15-ton travelling crane; (J) one cooling tower—for the Corporation. Mr. H. R. Burnett, Electricity Works, Barrow-in-Furness ... ... Nov. [illegible]

Last Day.

London.—The work and materials required in the construction of a new bridge over the Grand Junction Canal at Old Oak Lane, (near Willesden Junction) for the Light Railways and Tramways Committee of the Middlesex County Council. The contract will include the demolition of the old bridge and erection of a new span bridge in brick, stone, granite, and steel, preparatory to the laying of a new light railway. Mr. H. T. Wakelam, M.Inst.C.E., county engineer, Middlesex Guildhall, Westminster, S.W. ... ... Nov. 16

Fleetwood (Lancs.).—Construction of a new hulking adjoining the ferry landing at Knot End, near Fleetwood, for the Fleetwood Urban District Council. Mr. Edward Frobisher, Town Hall, Fleetwood Nov. 20

Waterford.—Supply and erection of a three-lift holder, for the City of Waterford Gas Company. Mr. R. Bruce Anderson, 5, Westminster Chambers, Victoria Street, London, S.W. ... ... —

COMING CONTRACTS.

Bath.—The Local Government Board has considered the report made by Mr. Hooper on the application of the Town Council for a loan of £19,000 for electric lighting purposes, and has sanctioned the borrowing by the Council of £18,120.

Shoreditch.—Two more turbine generators are to be obtained by the Borough Council at an estimated cost of £18,000.

Manchester.—Mr. H. Ross Hooper has held an inquiry into the City Council's application for power to [illegible] for the purpose of the electric supply undertaking.

Dundee.—The Tramways committee have decided to construct the Arbroath-road electric tramway line at [illegible]

Hackney.—The Finance committee have approved an expenditure of £4,[illegible] for work in connection with the scheme for taking condensing water from the river Lea for the electricity department.

Cheltenham.—Mr. W. O. E. Meade-King has held an [illegible] application of the town council for [illegible] sewerage works.

Coniston.—[illegible] has held an inquiry [illegible] purposes of a [illegible]

London.—The London County Council are about to invite tenders in connection with the reconstruction for electric traction of the first 22½ miles of the [illegible] system, which has just been acquired by [illegible] from the North Metropolitan Company.

CONTRACTS CLOSED.

Alloa. Messrs. Mackay Brothers, Alloa, have received an order from London owners for a steamer to carry 2,220 tons deadweight.

Derby. — The Parker Foundry Company, of Derby, have secured the contract for next year's supply of malleable iron castings to Messrs. Swan, Hunter and Wigham Richardson, Ltd., Wallsend-on-Tyne.

Bolton.—At the Hever Castle Power Station, Hever, Kent, four "Bennis" stokers and natural draught furnaces have been installed for use with Lancashire boilers.

Wolverhampton.—The Midland Electric Corporation for power distribution, Wolverhampton, have placed an order with Messrs. Ed. Bennis and Co. for three stokers and compressed air furnaces for water-tube boiler.

Durban.—Messrs. Hubert Davies and Spain's tender, at £4,528 17s. 3d. for tramway work has been accepted.

London. — The City Corporation has accepted the tender of Messrs Lund Brothers and Co., at £4,190, for installing the electric light in the Foreign Cattle Market, Deptford.

London County Council.—The Highways Committee has accepted the following tenders for the supply of low-tension cables and the laying of ducts in connection with the equipment of the through tramways between the Strand and the Angel, Islington: Low-tension cable: Callender's Cable and Construction Company, laying of ducts: £4,025; Mr. J. A. Ewart, London, £2,814. Messrs. Evered and Co. for the supply of the switchgear for the sub-station.

Pontypridd.—The Council have accepted the tender of the Brush Electrical Engineering Company, Ltd., for the equipment of the tramway from the town to Hafod, at £3,603, and that of Messrs. Henley's Telegraph Works Company for cables, at £2,585.

Leeds.—The contract for the construction of the New South Yorkshire Joint Railway has been secured by Messrs. Whitaker Brothers, of Horsforth, Leeds. The line is to extend from Kirk Sandal, on the Great Central Railway, to Laughton, and 60 bridges and 3,000 tons of steel girders are involved in the undertaking.

London.—The Brush Electrical Engineering Company, have received the following orders:—County of Durham Electric Power Distributing Company, ten 300 k.w. transformers; and J. Howden & Company, Glasgow, 150 k.w. dynamo.

Middlesbrough. — A contract has just been let by the London County Council for 4,210 tons of acid steel track rails at £7 7s. 6d. per ton to Bolckow, Vaughan and Co., Ltd., Middlesbrough, the total being £31,131 15s.

APPOINTMENTS VACANT.

Ipswich.—The Corporation invite applications for the post of engineer and manager of their waterworks. The salary will commence at £250 per annum. Mr. Will Bantoft, clerk, Town Hall, Ipswich. Nov. 16

Bolton. — The Bolton Corporation invite applications for the appointment of an assistant engineer in connection with extensions of their waterworks undertaking. Commencing salary £250 per annum. Mr. Samuel Parker, town clerk, Town Hall, Bolton ... ... Nov. 12

India Office. — For the service of the Government of India, an assistant for the carriage and wagon department of the North-Western Railway of India. Salary to commence at Rs.450 per month, rising by increments of Rs.50 per month yearly to a maximum of Rs.600 per month. Director-General of Stores, India Office, Whitehall, S.W. ... ... Nov. 13

India.—The Bombay, Baroda, and Central India Railway Co. invite applications for appointment as a chief draughtsman in the carriage and wagon department of the company's service. Salary, Rs. 400 per calendar month. Mr. T. W. Wood, Secretary, Gloucester House, Bishopsgate Street Without, London, E.C. ... ... Nov. 15

Gloucester.—The Corporation invite applications for the appointment of general manager of electric light railways within and near the city of Gloucester. Mr. Geo. Sheffield Blakeway, town clerk, Guildhall, Gloucester ... . Nov. 13

APPOINTMENTS FILLED.

Midland Railway.—Mr. Henry Fowler, gas engineer to the Midland Railway Company, has been appointed by the Directors to be in addition the assistant works manager of the locomotive department.

Willesden.—The Willesden Board of Guardians have appointed A. Moorhouse, of Burnley, engineer-in-charge in connection with their electrical installation.

London.—The Northampton Institute have made the following appointments for instructors in mathematics for their engineering courses: Mr. D. Heron, M.A., for day courses, and Mr. W. A. Pretty for evening courses.

West Ham.—Mr. R. Hugh Seabrook, of Barking, has been appointed electrical engineer to the West Ham Corporation.

London. — Dr. Alex. McKenzie, lecturer and senior demonstrator at the University of Birmingham, has been appointed head of the chemical department at Birkbeck College, in succession to Dr. J. E. Mackenzie.

Leith.—Mr. Lewis B. Barclay has been appointed engineer to the Water of Leith Purification and Sewerage Commissioners, at a salary of £200 per annum.

Portsmouth.—Mr. Herbert Chatley, of the borough engineer's department, Fulham, has been appointed Lecturer in Civil Engineering at the Portsmouth Technical Institute.

G.P.O.—Mr. A. E. Eames has been appointed senior assistant controller at the Central Telegraph Office.

Share List of Engineering, Electrical, Iron and Steel, and other Companies.

The following is a comprehensive list of Companies in the industries covered by "Page's Weekly," in which shares business is being currently transacted. Additions will be made from time to time as occasion requires. We desire it to be understood that while our Share List will generally be found correct, we do not hold ourselves responsible for any loss or inconvenience that may arise from possible inaccuracies.

STOCK EXCHANGE SETTLING DAYS. Settling days on the Stock Exchange are as follows:—
Consols: Dec 1st. General Settlements: Nov 15th, 30th, Dec 14th, 29th. Bank Rate, September 28th, 1905, 4 per cent.

I.—ENGINEERING, IRON, AND STEEL COMPANIES.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
11,370	5	5%	Alldays & Onions Pneumatic Engineering, Ltd.	3	[illegible]
10,000	5	3/-	Do. Cum. Pref. 6 per cent. ..	5	[illegible]
3,210,000	1	1/-	Armstrong (Sir W. G.), Whitworth and Co., Ltd.	1	[illegible]
76,970	5	2/-	Do. 4% Cum. Pref.	5	[illegible]
1,500,000	100	4%	Do. 4% 1st Mort. Dbs. Rd.	100	103 —105
£100,000	100	4½%	Aveling and Porter, Ltd., 4½% Reg Mt. Debs. Red.	100	96 — 99
530,000	1	1/7½	Babcock and Wilcox, Ltd., Ord. ..	1	3¾ – 4
100,000	1	7½d.	Do. „ 6% Cum. Pref.	1	[illegible]
20,000	5	3/-	Baker (Joseph) and Sons, Ltd., 6% Cum. Pref.	5	5 — 5½
250,000	1	6⅝d.	Baldwins, Ltd., 5⅝% Cum. Pref. ..	1	[illegible]
£250,000	Stk	4½%	Do. 1st Mt. 4½% Deb. Stk. Red.	100	102 —104
150,000	4½	2/8⅞	Barrow Hæmatite Steel Co., Ld., O.	4½	1⅜ – 1½
50,000	4½	3	Do. do. Cum 2nd. Pref.	4½	[illegible]
33,334	5	2/6	Bayliss, Jones and Bayliss, Ltd., 5% Cum. Pref. Shares	5	4¾ – 5¼
£500,000	100	4½%	Beardmore (Wm.) & Co., Ltd. 4½% 1st Mt. Debs., Red., Scrip 50% pd	—	[illegible]
50,000	10	6/-	Bell Brothers, Ltd., 6% Cum. Pref.	10	12¼ — 12[illegible]
£366,600	Stk	4%	Do 4% Deb. Stock, Red.	100	100—102
200,000	1	1/-	Beyer, Peacock and Co., Ltd., Ord.	1	[illegible]
300,000	1	6⅜d.	Do. 5⅜% Cum Pref.	1	[illegible]
£300,000	Stk	4¼%	Do. 4¼% Red. Deb. Stock	100	93 —96
1,629,760	1	6d.	Bolckow, Vaughan and Co., Ltd., O. Nos. 1-1,629,760	1	[illegible]
1,860,900	1	3½d.	Do. Nos. 1,639,101-3,500,000	12/-	[illegible]
1,160,000	1	10½d.	Brown (John) and Co., Lim., Ord., Nos. 1-1,160,000	15/-	[illegible]
590,000	1	1/2	Do. Ord., Nos. 1,160,001-1,750,000	1	[illegible]
74,000	10	5/-	Do. 5% Cum. Pref.	10	[illegible]
154,500	5	2/6	Cammell, Laird & Co., Ltd., Ord. ..	5	[illegible]
232,500	5	2/6	Do. 5% Cum. Pref. ..	5	[illegible]
450,000	1	1/2½	Clayton & Shuttleworth, Ltd., Ord.	1	[illegible]
70,000	5	2/6	Do. 5% Cum. Pref.	5	[illegible]
£250,000	Stk	4%	Do. 4% 1st Mort. Db. Stk. Red	100	100 -102
100,000	10	30/-	Consett Iron Co., Ltd., Ord.	7½	37– 38
57,031	10	10/-	Crossley, Bros, Ld, Ord. 40340/97370	10	[illegible]
40,339	10	5%	Do. 5% Cum. Pref.	10	11[illegible] 11[illegible]
75,000	1	2/6	Delta Metal, Ltd. Shares	1	[illegible]
1,259,594	1	3½d.	Dorman, Long & Co., Ltd.	1	[illegible]
£400,000	Stk	4%	Do. 4% 1st Mort. Perp. Deb. Stk.	100	[illegible]
200,000	5	3/-	Dunderland Iron Ore Co., Ltd., 6% Cum. Pref. and Participating ..	5	[illegible]
250,000	1	9½d.	Dunlop (James) & Co., Ltd., Ord. ..	1	[illegible]
300,000	1	7½d.	Do. 6% Cum. Pref. ..	1	[illegible]
4,721	13	13	Ebbw Vale Steel, Iron & Coal Co., Ltd.	13	[illegible]
69,754	13	10/-	Do. do. do.	10	9 —9½
20,250	10	[illegible]	Elliott's Metal, Ltd.	[illegible]	[illegible]
5,000	10	5%	Do. Cum. Pref. 5%	10	[illegible]
186,748	Stk	4%	Do. Deb. 4%	100	90 — 94
25,000	10	6/-	Fairfield Shipbuilding & Engng. Co., Ltd., 6% Cum. Pref. ..	10	[illegible]
£250,000	Stk	4½	Do. 4½% Mort. Deb. Stk. Red.	100	100 —103
126,000	3	8/-	Fraser & Chalmers, Ltd., Ord. ..	8	[illegible]
21,000	3	1/6	Do. 7½% Cum. Pref.	3	[illegible]
10,000	10	5%	Galloways, Ltd., 5% Cum. Pref. 1-001/28000	10	[illegible]
£150,000	Stk	4%	Do 4% 1st Mort Deb Red .	100	[illegible]
16,800	10	10%	Greenwood & Batley, Ltd., Ord. ..	10	[illegible]
9,600	10	7%	Do. 7% Cum. Pref.	10	10½— 11
965,000	1	1/-	Guest, Keen & Nettlefolds, Ltd. Ord.	1	[illegible]
344,000	5	2/6	Do. 5% Cum. Pref. ..	[illegible]	[illegible]
£1,850,500	Stk	4%	Do. 4% Irred. Mort. Deb. Stk	100	[illegible]
13,000	5	2/6	Gwynnes, Ltd., 5% Cum Pref.	[illegible]	[illegible]
[illegible]	1	1/-	Hadfield's Steel F'dry Co., Ld., Ord.	1	[illegible]
20,000	10	4/6	Do. 4½% Cum. Pref.	10	[illegible]
30,000	5	3/-	Hall (J. & E.), Ltd. 6% Cum. Pref. ..	[illegible]	5 — 5½
468,505	1	1/6	Harvey United Steel Co., Ltd. ..	1	[illegible]
47,500	10	7½%	Hawthorn, Leslie & Co., Ltd. Ord.	[illegible]	[illegible]
28,001	5	7%	Head, Wrightson & Co., Ltd.	[illegible]	[illegible]
85,000	1	7½d.	Hill (Richard) & Co. (1899) Ld., Ord.	[illegible]	[illegible]
18,000	5	3/-	Do. 6% Cum. Pref. ..	[illegible]	[illegible]
£100,000	Stk	6%	Hornsby (Richard) & Sons, Ld., Ord. 6% Cum Pref.	[illegible]	101—103

ENGINEERING, IRON, AND STEEL COMPANIES.—*Contd.*

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up.	Closing Prices.
750,000	1	7½	Howard & Bullough, Ltd., Ord. ..	1	[illegible]
2[illegible],000	10	6/-	Do. 6% Pref. (Non-Cum.) ..	10	12¼—13¼
£250,000	Stk	4%	Do. 4% Deb. Stk., Red. after 1905	100	96 — 99
37,500	10	20	Kynoch, Ltd.	10	18[illegible]—18¾
49,[illegible]37	10	5%	Do. Cum. Pref. 5% .. .	10	10⅞—11⅛
300,000	1	4%	Lambert Bros., Ltd., Ord.	1	[illegible]
50,000	5	2/9	Do. 5½% Cum. Pref . .	5	4—4½
40,000	3	2/1	Leeds Forge Co., 7% Cum. Pref. ..	3	4— 4¼
200,000	1	7½d.	Lysaght (John), Ltd., 6% Cum. Pf.	1	[illegible]
£300,000	Stk	4½%	Do. 4½% 1st Mt. Deb. Stk., Red.	100	108 —110
40,000	10	5/-	Mather & Platt, Ld., 5% Cum. Pref	10	11¼—11¾
210,000	1	[illegible]d.	Measures Bros., Ltd., Ord.	1	[illegible]
75,000	1	6½d.	Do. 5½% Cum. Pref.	1	[illegible]
£75,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	98 - 101
21,943	5	2/6	Muntz Metal, Ltd.	5	4½— 5
14,248	5	5%	Do. Pref. 5%	5	4⅞— 5⅛
5,000	62½	47/6	Nantyglo and Blaina Iron Works, Ltd., 8% Cum. Pref.	62½	80 — 88
73,000	10	5/-	N. Brit. Loco. Co., Ltd., 5% Cm. Pf.	10	12⅛—12⅝
80,000	5	—	North-Eastern Steel Co., Ltd.,		
£250,000	Stk	4½%	4½% 1st Mrt. Db. Stk., Red.	100	89 — 93
122,000	5	1/6	Pearson & Knowles Coal and Iron Co., Ltd., Ord., "B"	5	5 — 5½
50,000	5	3/-	Do. 6% Cum. Pref. "A" ..	5	6 — 6½
70,000	10	10/-	Pease & Partners, Ltd., Ord. ..	10	12¾—13¼
£400,000	Stk	4%	Do. 4% Perp. Deb. Stock .	100	100—103
20,000	5	3/-	Peebles Bruce & Co., Ld., 6% Cm.P.	5	4⅝— 5⅛
65,000	1		Pooley (Henry) & Son., Ltd., Ord ..	1	11/- —11/6
13,000	5	-	Do. 5½ Cum Pref. .. .	5	4⅝— 4⅞
230,000	1		Projectile Co. (1902), Ltd., Ord. ..	1	[illegible]
126,988	5	2/-	Rhymney Iron Co., Ltd. .. .	5	2— 2¼
73,062	5	2/-	Do. New	5	1¾— 2⅛
£330,000		5%	Do. 5% Mort. Deb., Red. ..	100	102—104
350,000	1	7½d.	Richardsons, Westgarth & Co., Ltd., Ord. 350,001—700,000 ..	1	1 1/16 —1⅛
£350,000	1	7	Do. 6% Cum. Pref.	1	1 — 1⅛
£350,000	Stk	4½	Do. 4½% Perp. Deb. Stock ..	100	97 — 100
35,000	10	12/-	Ruston, Proctor & Co., Ltd... .	10	10[illegible] —10[illegible]
275,000	1	6d.	Scott (Walter) Ltd., Ord.	1	[illegible]
300,000	1	7½d.	Do. 6% Cum. Pref. ..	1	[illegible]
£300,000	Stk	4	Do. 4% Perp. Deb. Stk.	100	94 — 97
£115,300	100	5%	Shelton Iron, Steel and Coal Co., Ld. 1st Charge 5% Debs., Red ..	100	94 — 97
£97,900	100	6	Do. 6% 2nd Mort. Debs., Red.	100	96 —100
250,000	1	1/-	South Durham Steel & Iron, Ltd. Or.	1	[illegible]
300,000	1	1/-	Do. 6% Cum. Pref...	1	[illegible]
£300,000	Stk	4½	Do. 4½% Per. Deb. Stock	100	93 — 96
25,000	10		Stephenson (Robert) & Co., Ltd., Or.	10	2¾— 3¼
25,000	10	5/6	Do. 5½% Cum. Pref. ..	10	5¼— 5¾
£250,000	Stk	4	Do. 4% Perp. Deb. Stock	100	80— 83
85,000	10	[illegible]	Stewarts & Lloyds, Ltd., Ord. ..	10	19¾ - 20¼
55,000	10	[illegible]	Do. 6% Cum. Pref. .	10	14½ - 15
[illegible]	1	6d	Swan, Hunter & Wigham Richardson, Lim. Ord.	1	[illegible]
[illegible]	1	6d	Do. 5% Cum. Pref. .	1	[illegible]
£240,000	Stk	4½	Do. 4½% 1st Mort Deb Stk Red	100	96 — 99
300,000	1	[illegible]	Thames Iron Works, Shipbuilding & Engineering Co., Ltd., 5% Cum. Pf.	1	[illegible]
£[illegible]	100	4%	Do. 4% Irredeem. 1st Mort. Deb.	100	81 — 84
£118,500	1	7½d.	[illegible], Ltd. Or.	1	[illegible] 1
£160,000	1	[illegible]	Do. do. 6% Cum. Pref.	1	[illegible]
10,000	10	[illegible]	[illegible] Cum. Pf.	10	9¼— 9¾
[illegible]	[illegible]	[illegible]	United States Steel Corp. Com. Stk.	$100	38¾ - 39
[illegible]	[illegible]	[illegible]	Do. 7% Cum. Pref. Stock	$100	107½— 108
[illegible]	[illegible]	[illegible]	Do. 10-60yr. 5% Skg. Fd. G. Bds.	$1000	99—101
[illegible]	1	[illegible]	Vickers, Sons & Maxim, Ltd. Ord	1	[illegible]
[illegible]	1	[illegible]	Do. 5% Non-Cum. Pref. ..	1	[illegible]
£750,000	[illegible]	[illegible]	Do. [illegible] Cum. Pref. Stock	100	120 — 123
[illegible]	[illegible]	[illegible]	Do. [illegible] Mort. Deb. Stk. Red	100	104½—106½
£1,000,000	[illegible]	[illegible]	Do. [illegible] Deb. Red	100	106 — 108
[illegible]	1	[illegible]	[illegible], Ltd., Def. Ord.	1	[illegible]
[illegible]	[illegible]	[illegible]	Do. [illegible]	1	[illegible]
[illegible]	[illegible]	[illegible]	Do. 4% Perpetual Deb. Stock	100	88 — 91
[illegible]	[illegible]	[illegible]	Weldless Steel Tube, Ltd., Cum. Pref. 5½	5	4½ - 4¾
[illegible]	[illegible]	[illegible]	Do. Mort. Deb. [illegible]	100	92 — 98
[illegible]	[illegible]	[illegible]	[illegible], Ord. . ..	5	1½ - 2
[illegible]	[illegible]	[illegible]	Do. [illegible] Pref. ..	5	2½ — 3½
[illegible]	[illegible]	[illegible]	Do. 4% 1st Mort. Deb. Stk. Red	100	77 — 82
£150,000	[illegible]	[illegible]	Yorkshire Iron & Coal Co., Ltd., [illegible] Mort. Deb. Stk. Red.	100	71 —76

Stocks and Shar[illegible]

II.—ELECTRICAL MANUFACTURING COMPANIES.

Present Amount Subscribed	Shares.	Last Dividend.	Name	Paid up.	Closing Prices.
70,000	1	6d.	Alliance Elec. Co., Ltd. 5% Cum. Pf.	1	⅝— ⅞
125,000	1	7½d.	Aron Elec. Meter Ltd., 6% Cum. Pf.	1	7/16— 9/16
120,000	1	1/2¾	Bell's Asbestos Co., Ltd.	1	1 5/16—1 7/16
£40,000	5	9d	British Aluminium Co 7% Cum Pref.	5	5 — 5½
£300,000	Stk	5%	Do. 5% 1st Mort. Deb. Stk. Rd.	100	98 —102*
100,000	5	4/-	British Insulated & Helsby Cables Ltd., Ord. ..	5	6¾— 7¼
100,000	5	3/-	Do. 6% Cum. Pref.	5	5¾— 6¼
£500,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Rd.	100	103 —106
£200,000	Stk	4½%	British Thomson-Houston Co., Ltd., 4½% 1st Mort. Deb. Stk. Red. ..	100	98 —100
400,000	5	8/-	British Westinghouse Electric and Manufac. Co., Ltd., 8% Pref. ..	5	2⅜ — 2⅝
£616,358	Stk	4%	Do. 4% Mort. Deb. Stk. Red...	100	85 — 89
105,731	2	2/-	Brush Elec. Enging. Co., Ltd., Ord. .	2	½— ¾
150,000	2	2/4¾	Do. 6% Pref.	2	1¼— 1¾
£125,000	Stk	4½%	Do. 4½% Perp. 1st Deb. Stk...	100	93 — 97
£125,000	Stk	4½%	Do. 4½% Perp. 2nd Deb. Stk.	100	78 — 81
35,000	5	7/6	Callender's Cable & Constn. Ltd. Ord.	5	11 — 12*
40,000	5	2/6	Do. 5% Cum. Pref.	5	5⅝— 5⅞
£200,000	Stk	4½%	Do. 4½% 1st Mort. Deb Stk. Red.	100	109 —111
85,000	3	1/6	Crompton & Co., Ltd...	3	1½—1¾
£100,000	—	5%	Do. 5% 1st Mort. Reg. Debs.	100	94 —99%
52,000	5	10/-	Dick, Kerr & Co., Ltd., Ord. ..	5	8½— 9
61,000	5	8/-	Do. 6% Cum. Pref.	5	6 — 6½
£800,000	Stk	4½%	Do. 4½% Deb. Stock, Red. ..	100	106 —108
233,334	1	6d.	Doulton & Co., Ltd., 5% Cum. Pref.	1	1⅛— 1⅜
£233,334	Stk	4%	Do. 1st Mort. 4% free. Deb. Stk.	100	107 —110
99,261	5	1/6	Edison and Swan United Electric Light, Ltd., "A" Shares Nos. 1-99,261	3	1⅜— 1⅝
17,139	5	2/6	Do. "A" Shares Nos. 01-017,139	5	2 — 2½
£344,023	Stk	4%	Do. 4% Deb. Stock Red. ..	100	85 — 90
£100,000	Stk	5%	Do. 5% Second Deb. Stk. Red.	100	93 — 97
112,100	2	1/7½	Electric Construction Co., Ltd. ..	2	⅝— ⅞
31,390	2	2/9¾	Do. 7% Cumulative Pref. ..	2	1⅞— 2⅛
£200,000	Stk	4%	Do. 4% Perp. 1st Mt. Deb. Stk.	100	92 — 95
10,248	10	7/6	Evered and Co., Ltd...	10	10 — 12
25,000	10	5/-	Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref.	10	9½— 10
£200,000	Stk	4%	Do. 4% 1st. Mt. Deb. Stk., Red.	100	96—100
85,000	5	5/-	Henley's (W. T.) Telegraph Works Co., Ltd., Ord.	5	12 —13
35,000	5	2/3	Do. 4½% Cum. Pref. ..	5	5⅛— 5⅜
£50,000	Stk	4½%	Do. 4½% Mt. Deb. Stk. Red.	100	109—111
50,000	10	6/-	India Rubber, Gutta Percha & Telegraph Works Co., Ltd.,	10	15½—16½
£300,000	100	4%	Do. 1st Mort. Deb. Red. ..	100	99 —102
7,500	10	—	Parker, Thos., Ltd.	10	6½— 7
100,000	1	3%	Scott (Ernest) & Mountain, Ld., Ord.	1	17/3—17/9
37,350	12	12/-	Telegraph Construction and Maintenance Co., Ltd.	12	33½— 35½
£150,000	100	4%	Do. 4% Deb. Bonds	100	102 - 104

III.—ELECTRIC TRACTION.

Present Amount Subscribed	Shares.	Last Dividend	Name.	Paid up	Closing Prices.
120,000	5	5/-	Anglo-Argentine Trams Co., Ld., Or.	5	8½ — 8⅞
260,007	5	2/6	Do. 5% Cum Pf.	5	5⅛ - 6⅛
£230,000	Stk	6%	Do. Permanent 6% Debenture Stock, 1888 ..	100	141 144
20,000	10	12/-	Barcelona Trams Co., Ltd., Ord. ..	10	13¾ — 14¼
10,000	10	5/-	Do. 5% Cum Pf. Shares	10	9½ — 10
£46,300	100	5%	Do. 5% Debs., Red. ..	100	98 —101
£191,326	Stk	4½%	Do. 4½% Red. Deb. Stk.	100	97 —102
75,666	1	—	Bath Elec. Trams. Ld., Pf. Or. ..	1	⅞ — 1
99,394	1	11·1d	Do. 5% Cum. Pf. ..	1	15/16—1 1/16
75,000	5	—	Brisbane Electric Tram Investment Co., Ltd., Ord... ..	5	1 — 1½
75,000	5	2/6	Do. 6% Cum. Pf. ..	5	3¾ - 4¼*
£42.,000	Stk	4½%	Do 4½% 1st Deb. Stk, Red.	100	95 - 98
£200,000	Stk	6%	Brit. Columbia Elec. Rly. Co., Ltd., Def. Ord. Stock	100	123 126*
		5%	Pref. Ord. Stock	100	109—112
133,301	10	6/-	Brit. Electric Traction, Ltd., Ord.	10	9⅞—10⅛
133,127	10	6/-	Do. 6% Cum. Pref.	10	11 —11⅛
£1,000,000	Stk	5%	Do. 5% Perp. Deb. Stk. ..	100	121 —123
£250,000	Stk	4½%	Do. 4% 2nd Deb. Stk. Red..	100	97 99*
100,000	5	2/6	Buenos Ayres & Belgrano Electric Trams, Ltd., Ord.	5	3 11/16 - 3 15/16
40,500	5	3/-	Do. "A" 6% Cum Pref. ..	5	5 1/16 - 5 5/16
27,000	5	3/-	Do. "B" do.	5	5 — 5½

ELECTRIC TRACTION.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£200,000	Stk	5%	Buenos Ayres Elec. Trams Co. (1901) Ltd., 5% Db. Stk., Red.	100	98—100
£220,000	100	6%	Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds.	100	101—105
102,268	5	5/-	Calcutta Tramways Co., Ltd. ..	5	9½— 9½
£350,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	107 -109
480,000	1	6d.	Cape Electric Tramways, Ltd. ..	1	1 — 1¼
40,000	5	2/6	City of Birmingham Trams Co., Ltd. 5% Cum. Pref.	5	4⅞—5⅛
£300,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	101—103
£120,000	Stk	5%	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red.	100	102—104*
60,000	10	6/-	Dublin United Trams. Co. (1896), Ltd., Ord. ..	10	13½—14½
59,987	10	6/-	Do. 6% Pref...	10	15 — 16
30,000	5	2/6	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	2¼— 2¾
£150,000	Stk	4%	Do. 4% Deb. Stock.. ..	100	83 — 88
125,000	10	5/-	London United Trams. (1901), Ltd., 5% Cum. Pref.	10	9¾—10¼
£1,031,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	100—103
£50,000	Stk	5%	Madras Electric Trams (1904), Ltd., 5% Deb Stock, Red.	100	103 —105
314,016	1	—	Metropolitan Elec. Trams, Ltd., Def.	1	½— ⅝
500,000	1	6d.	Do. 5% Cum. Pref... ..	1	1 —1 1/16
£350,000	Stk	4½%	Do. 4½% Deb. Stock, Red.	100	106 —108
50,000	5	6/-	New General Traction Co., Ltd., 6% Cum. Pref.	5	½— 1½
110,923	8	2/9¾	North Metropolitan Tramways Co..	8	4½— 4¾
£150,000	100	3½%	Do. 3½% Mort. Debs.	100	93 — 98
£196,200	Stk	5%	Perth Electric Trams, Ltd. (W.A.) 5% 1st Mort. Deb. Stock, Red..	100	104 —107
24,500	10	10/-	Potteries Elec. Traction Co., Ld., Or.	10	8¾— 9¼
24,500	10	5/-	Do. 5% Cum. Pref. ..	10	9¼ — 9¾
£220,000	Stk	4½%	Do. 4½% Deb. Stk., Red.	100	102 —105

IV.—ELECTRIC LIGHTING AND POWER.

Present Amount Subscribed	Shares.	Last Dividend	Name	Paid up	Closing Prices
7,500	10	14/-	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord. ..	10	12¼— 12¾
7,500	10	4/6	Do. 4½% Cum. Pref. ..	10	10⅛—10⅝
7,500	10	6/-	Do. 6% Cum. Second Pf. ..	10	11¾ — 12¼
£70,000	Stk	4½%	Do. 4½% Deb. Stock Red ..	100	107 —109
14,000	5	3/6	Bromley (Kent) Elec. Lt. & Pr. Co. Ld	5	5¼— 5¾
£50,000	Stk	4½%	Do. do 4½% 1st Deb. Stk. Red.	100	102 —105*
27,507	5	4/6	Brompton & Kensington Elec. Supply Co., Ltd. Ord. ..	5	9¾— 10¼
12,493	5	3/6	Do. 7% Cum. Pref. Shares..	5	9¼— 9¾
60,000	5	5/-	Calcutta Elec. Sup. Cor. Ltd., Ord..	5	9 — 9½
£288,782	Stk	4%	Central Elec. Sup. Co., Ltd., 4% Gua. Deb. Stk. ..	100	105 —108
70,000	5	2/6	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord... ..	5	7½ — 8
80,000	5	2/3	Do. do. 4½% Cum. Pref...	5	5¼ — 5¾
£350,000	Stk	4%	Do. do. 4% Deb. Stk. Red.	100	103 —105
41,436	5	2/3	Chelsea Elec. Sply. Co., Ltd., Ord.	5	5¾— 6¼
£150,000	Stk	4½%	Do. do. 4½% Deb. Stk., Red	100	110 —112
70,595	10	7/-	City of London El. Lghtg. Co., Ld., O.	10	12½— 12⅞
40,000	10	6/-	Do. 6% Cum. Pref.	10	13¼ - 14¼
£400,000	Stk	5%	Do 5% Deb. Stk., Red ..	100	124 128
£300,000	Stk	4½%	Do. 4½% 2nd Deb. Stk., Red	100	104 —106
40,000	10	4/-	County of London Elec. Supply Co., Ltd., Ord.	10	9¾ - 10¼
30,000	10	6/-	Do. 6% Cum. Pref.	10	12¼ - 12¾
£400,000	Stk	4½%	Do. 4½% Deb. Stk., Red. ..	100	111 —114
70,000	5	2/6	Edmundson's Elec. Cor. Ltd., Ord.	5	5½— 6
70,000	5	3/-	Do. 6% Cum. Pref.	5	6¼—6¾
£300,000	Stk	4½%	Do. 4½% 1st Mort. Db. Stk. Reg	100	109 111
£80,000	Stk	5%	Electric Lighting & Traction Co. of Australia, Ltd. 5% Deb. Stk. Red.	100	85 — 90
10,000	5	2/-	Folkestone Elec. Supply Co., Ld., O..	5	5¼ — 5¾
£50,000	Stk.	4½%	Do. 4½% 1st Deb. Stk., Red.	100	100 —103
15,000	10	—	Havana Electricity Co., Ltd... ..	10	9 — 10
13,000	5	5/-	Hove Elec. Lighting Co., Ltd., Ord.	5	8⅛— 8⅝
£50,000	Stk	4½%	Isle of Wight Electric Light & Power Co., Ltd. 4½% Deb. Stock, Red.	100	99 —101
150,000	1	—	Kalgoorlie Electric Power & Lighting Corp, Ltd., 6% Cum. Pref.	1	1/16 — 1/8
21,000	5	5/-	Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord. ..	5	12 —12½

Stocks and Shares marked * are quoted ex-dividend

ELECTRIC LIGHTING AND POWER.—*Contd.*

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
£135,000	Stk	4%	Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd., 4% Deb. Stock, Red.	100	98 –101
111,000	3	1/9¾	London Elec. Supply Corp., Ld., Ord.	3	2 – 2¼
60,000	5	8/-	Do. 6% Pref.	5	[illegible]
£371,895	Stk	4%	Do.. 4% 1st Mort. Db. Stk., Red.	100	99 –102
100,000	10	5/-	Metropolitan Elec. Sup. Co., Ld., Or.	10	10 10½
76,121	5	2/3	Do. 4½% Cum. Pref.	5	5½— 5¾
220,000	Stk	4½%	Do. 4½% 1st Mort. Db. Sk., Red.	100	109 –111
250,000	Stk	3½%	Do. 3½% Mort. Deb. Stk., Red.	100	[illegible] –100
£250,000	—	4½%	Midland Elec. Corp. for Power Distribution, Ld., 4½% 1st Mort. Deb.	100	101–103%
10,852	10	8/-	Notting Hill Elec. Ltg. Co. Ltd. Ord.	10	14 – 15
£59,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	98 –100
16,500	5	2/6	Oxford Electric Co. Ltd., Ord. ..	5	6 – 6½
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	100 –102
£84,700	100	4½%	Royal Elec. Co. (of Montreal) 4½% 20-yr. 1st Mort. Deb	100	100 –102
40,000	5	5/-	St. James' & Pall Mall Elec. Light Co., Ltd. Ord.	5	14 — 15
20,000	5	3/6	Do. 7% Pref...	5	[illegible]
£150,000	Stk	3½%	Do. 3½% Deben. Stock, Red	100	98 –100
12,000	5	4/-	Smithfield Markets Elec. Supply Co., Ltd. Ord.	5	2 — 2½
£50,000	Stk	4%	Do. 4% Debenture Stk Red.	100	76 — 80
65,000	5	4/-	South London Elec. Sup. Co., Ltd. O.	5	3½ — 4
100,000	1	—	South Metropolitan Elec Light & Power Co., Ltd. Ord.	1	[illegible]
50,000	1	8½d.	Do. 7% Cum. Pref.	1	1⅛ –1¼
£100,000	Stk	4½%	Do. 4½% 1st Deb. Stock Red.	100	105 –108
50,000	5	2/6	Urban Electric Supply Co., Ltd., O.	5	4½ — 4¾
30,000	5	2/6	Do. 5% Cum Pref.	5*	5 — 5½
£200,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Red	100	103 –10[illegible]
110,000	5	6/6	Westminster Elec. Supply Corp. Ltd., Ord.	5	12½ 12¾
28,151	5	2/6	Do. 5% Cum. Pref.	5	6 — 6½

V.—TELEGRAPH & TELEPHONE COMPANIES.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
£34,800	100	4%	African Direct Tel. Co., Ld., 4% Mt. Debs. (Series A), Red. ..	100	99 –102
25,000	10	—	Amazon Telegraph Co., Ld... ..	10	3½ — [illegible]
£763,580	Stk	14/-	Anglo-American Tel. Co.. Ltd., Ord.	100	60 62
£3,118,210	Stk	28/-	Do. 6% Preferred Ordinary	100	107½ –108
£3,118,210	Stk	2/-	Do. Deferred Ordinary ..	100	15 – 15½
44,000	5	5/-	Chili Telephone Co., Ltd.	5	7¼ — 7¾
$15,000,000	$100	$2	Commercial Cable Co., Capital Stk.	$100	—
£1,903,856	Stk	4%	Do. Sterl. 500-yr 4% Deb. Stk., Red.	100	97 99
16,000	10	5/-	Cuba Submarine Tel. Co., Ld., Ord.	10	[illegible]
6,000	10	10/-	Do. 10% Preference	10	17 –18*
6,000	5	2/-	Direct Spanish Telegraph Co., Ord.	5	3½ 3¾
		5/-	10% Cum. Preference	5	9¼ 9¾
£30,000	50	4½%	Do. 4½% Debs..	50	100 103
60,710	20	4/-	Direct U.S. Cable Co., Ltd... ..	20	13 13½
£85,800	100	4½%	Direct West India Cable Co., Ltd., 4½% Reg. Debs.	100	100 –102
£300,000	100	4%	East. & S. African, Ld., 4% Mt. Dbs.	100	99 –101½
£200,000	25	4%	Do. 4% Rg. Mt. Dbs. (Mauritius Subsidy)..	25	101½ 103½%
300,000	10	2/6	Eastern Extension, Australasia and China, Ltd...	10	[illegible]
£602,400	Stk	4%	Do. 4% Mort. Deb. Stk., Perp.	100	106 –108
£4,000,000	Stk	25/-	Eastern Tele. Co., Ltd., Ord. ..	100	143 –146
£2,000,000	Stk	17/6	Do. 3 % Pref.	100	89 –91
£1,886,814	Stk	4%	Do. 4% Mort. Deb.	100	106 –108*
150,000	10	5/-	Great Northern Telegraph Co., Ltd., (of Copenhagen) ..	10	[illegible]
£58 700	100	4½%	Halifax and Bermudas Cable Co., Ltd., 4½% 1st. Mort. Debs. Red.	100	100–102
17,000	25	12/6	Indo-European Tele. Co., Ltd. ..	25	[illegible]
72,680	1	7½d.	Monte Video Telephone Co., Ltd., O.	1	[illegible]
£1,983,333	Stk	6%	National Telephone Co., Ltd., Pref.	100	[illegible]
£1,966 667	Stk	5%	Do. Deferred	100	107–108
250,000	5	2/6	Do. 5% Non-Cum. 3rd Pref.	5	[illegible]
£2,000,000	Stk	3½%	Do. 3½% Deb. Stk., Red. ..	100	[illegible] 100
£689,593	Stk	4%	Do. 4% do. do. ..	100	[illegible]
179,313	1	8½d.	Oriental Telephone & Elec. Co., Ltd.	1	[illegible]
50,000	1	7½d.	Do. 6% Cum. Pref.	1	[illegible]
£100,000	100	4%	Pacific & European Tel. 4% Guar. Debs. Red...	100	100–103
11,839	8	4/-	Reuter's Telegram Co., Ltd. ..	8	[illegible]
68,000	5	3/-	United River Plate Telep. Co., Ltd.	5	[illegible]
40,000	5	2/6	Do. 5% Cum. Pref.	[illegible]	[illegible]
£179,947	Stk	5%	Do. 5% Deb. Stock, Red. ..	100	[illegible]
15,609	10	5/-	W. African Telegraph Co., Ltd. ..	10	10–10½
£30,008	2½	-	West Coast of America, Ltd. ..	[illegible]	[illegible]
150,000	100	4%	Do. 4% Deb. Guar. by West. Tel.	100	[illegible]

TELEGRAPHS AND TELEPHONES.—*Contd.*

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up.	Closing Prices.
88,321	10	6d.	W. India & Panama Teleg. Co., Ld., Or.	10	11/16 — 13/16
34,563	10	6/-	Do 6% Cum. 1st. Pref. ..	10	8½ – 9
4,669	10	6/-	Do. 6% Cum. 2nd Pref. ..	10	7½ — 8
£80,000	100	5%	Do. 5% Deb.	100	101 —104
207,930	10	8/-	Western Telegraph Co., Ltd. ..	10	14½—14¾
£75,000	100	5%	Do. 5% Debs., 2nd Series, 1906	100	101 —103
518,945	Stk	4%	Do. 4% Deb. Stock, Red. ..	100	102½—104½

VI.—SHIPPING COMPANIES.

Present Amount Subscribed.	Shares	Last Dividend	Name	Paid up.	Closing Prices
32,500	10	5/6	Anchor Line (Henderson Bros.), Ltd., 5½% Cum. Pref.	10	9 — 9½*
£325,000	Stk	4½%	Do. 4½% Red. 1st Mort. Deb. Stk.	100	99 —101*
£672,900	Stk	4½%	British & African Stm. Nav. (1900), Ltd., 4½% 1st Mort. Deb. Stk.. Red.	100	98 —100
10,000	10	5/6	Bucknall Steamship Lines, Ltd., 5½% Cum. Pref.	10	5¾— 6¼
£600,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk.	100	89 — 92
£750,000	Stk	4½%	Clan Line Steamers, Ltd., 4½% Deb. Stk. Red. ..	100	99 —101
60,000	20	16/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000..	20	14½- 15
40,000	20	8/-	Do. Nos. 60,001-100,000	10	6½— 7
£464,430	Stk	4½%	Elder Dempster Shipping, Ltd., 4½% 1st Mort. Deb. Stk. ..	100	102—104*
1,200,000	1	6d.	Furness, Withy & Co., Ltd., Ord...	1	1½ –1⅝*
25,328	7½	4/7	Gen. Steam Navigation Co., Ld., Ord.	7½	5½— 5¾
36,758	8	4/9¾	Do. Non-Cum. 6% Pref... ..	8	8½— 9
£150,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	98 —100
55,000	5	1/3	Houlder Line, Ltd., Ord.	5	2 — 2½
40,000	5	2/9	Do. 5½% Cum. Pref.	5	2¾— 3¼
£200,000	Stk	4½%	Do. 4½% 1st Mt. Deb. Stk. Red.	100	86 — 88
141,500	10	5/-	Leyland (Fredk.), & Co.. (1900), Ltd., 5% Cum. Pref. ..	10	5¾— 6¼
£1,160,000	Stk	5%	Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref. ..	100	127—130
£1,160,000	Stk	19%	Do. do Deferred ..	100	243—246
15,000	100	30/-	Royal Mail Steam Packet Co. Ord..	60	45— 47
39,075	5	2/6	Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref..	5	4¾— 5¼*
39,075	5	2/6	Do "B" Ord..	5	3¾— 4¼*
141,841	10	4/-	Union Castle Mail Steamship Co., Ltd., Ord..	10	8½— 9*
21,000	10	4/6	Do. 4½% Cum. Pref... ..	10	10½— 11
£1,008,894	Stk	4%	Do. 4% Debenture Stk., Red.	100	100 —102

VII.—MISCELLANEOUS COMPANIES.

Present Amount Subscribed.	Shares	Last Dividend	Name.	Paid up.	Closing Prices.
60,000	1	9½d.	Chadburn's (Ship) Tele. Ltd., Ord...	1	1 3/16 —1 5/16
£750,000	Stk	[illegible]	General Hydraulic Power Co., Ltd.	100	123 —128
12,500	10	10%	Oakey (John) and Sons, Ltd., Ord..	10	25 — 27
10,000	10	6/-	Do do. 6% Cum. Pf.	10	14 — 15*
183,538	1	6·3d.	Power Gas Corp., Ltd., Ord., Nos. 66,463-250	15/-	½ — ⅝
66,462	1	8·4d.	Do. do Nos. 1-66,462	1	⅜— ½
135,000	1	6d	Waygood (R.) & Co., Ltd., Ord. ..	1	1⅛ –1¼
135,000	1	7½d.	Do. 6% Cum. Pref. ...	1	1 3/16 — 1¼

RAILWAY CARRIAGE & WAGON COMPANIES.

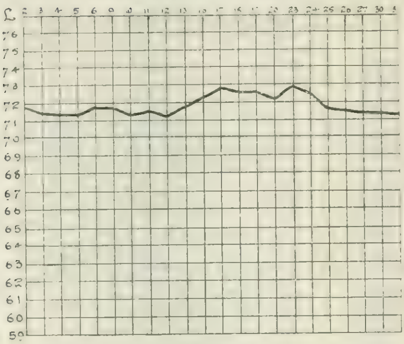
Present Amount Subscribed.	Shares	Last Dividend	Name	Paid up	Closing Prices.
10,000	10	7/6	Birm. Railway Car. & Wagon, L., 1-10,000	10	25 — 26
8,739	10	3/-	Do. Second Issue 1-8,739....	4	9½— 9¾
10,000	10	6/-	Do. Cum. Pref. 6% 1-10,000..	10	13 –14⅛
30,111	7	7/-	Gloucester Rail. Car & Wagon, Ld., A, 1-29,862 & 49,751-50,000	7	10¼— 10½
[illegible]	7	[illegible]	Do. B, 29,863-49,750, 50,001-75,000	7	4½— 4¾
[illegible]	10	1/3	Lancashire Wagon, Ord.	2	2¼— 2¾
4,150	10	5%	Do. do.	10	10⅜–10⅝
784,808	1	9d.	Metropolitan Amalgamated Rail. Carriage & Wagon, Ld., 1-784,808	1	44/- — 46/-
164,288	1	6d.	Do. Cum. A Pref. 5%, 1-164,288	1	24/- —24/6
235,000	1	7½d.	Do. Cum. B Pref. 6%, 1-235,000	1	27/ –28/
20,000	10	20/-	Midland Rail. Car & Wagon, L.d., 1-20,000	10	20¼— 21¼

Stock and [illegible] quoted ex-dividend

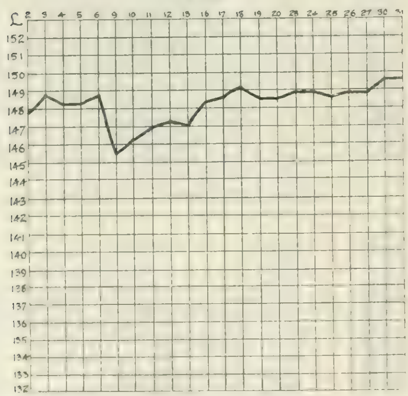
THE HOME METAL MARKET.

SHOWING DAILY FLUCTUATIONS FROM OCTOBER 2ND TO OCTOBER 31ST, 1905.

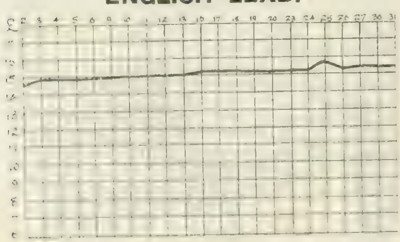
COPPER.



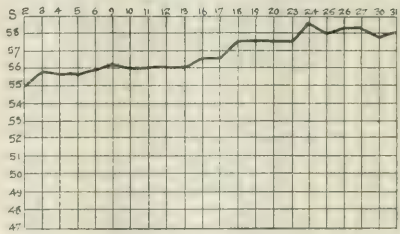
TIN.



ENGLISH LEAD.



PIG IRON: SCOTCH,



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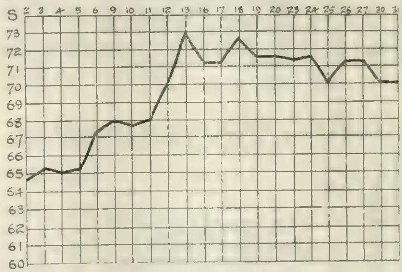
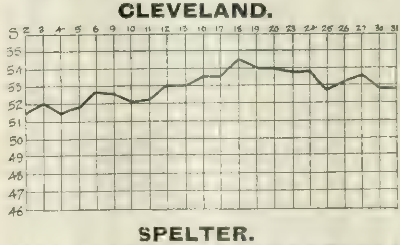
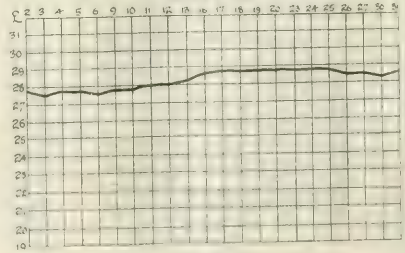


CLEVELAND.



SPELTER.



PRICES CURRENT OF COAL, IRON, STEEL, AND OTHER METALS.

MANUFACTURERS' AND MERCHANTS' QUOTATIONS.

MARKET REPORT.

Wednesday, November 1st, 1905.

COPPER, after advancing sharply to £72 15s., is now rather easier, consequent upon the reserve exhibited by buyers. No doubt the relapse in the pig-iron market had a prejudicial effect, and, although the metal remains firm, no marked rise in values is likely to be witnessed in the immediate future. The consumptive demand is slow, but values for refined copper have been well maintained. The closing quotations are £71 5s cash, and £70 7s. 6d. three months.

The Tin market, after an uneventful week, is stronger on good Eastern advices and a resumption of buying on the part of American consumers. It is understood that manufacturers in the States have allowed their stocks of the metal to run down to an extremely low level, and the fresh purchasing orders now recorded have been confidently expected for some little time past. Prices during the week have moved within comparatively narrow limits, but it is noteworthy that the attempts to depress the market on the part of bears have altogether failed, and, as indicated above, the tone is now stronger. Closing prices are £149 15s. cash and £149 three months.

In the Iron and Steel section the activity which has characterised the market for some time past is no longer in evidence. The strong bear attack made last week had the effect of squeezing out weak holders, and bringing about a sharp relapse in prices. The general opinion, however, is that the weeding-out process has strengthened the position, as the market showed signs of being overbought. As was only natural the sharp fall was followed by bear covering and the market is harder again, Cleveland being quoted 52s. 10½d., with hematite 70s. 4½d. and Scotch 57s. 9d.

The Lead market at the time of writing shows renewed firmness and prices have once more reached £15.

Efforts were made by Continental dealers to depress the London market for Spelter, probably with a view of facilitating negotiations for purchases of American spelter. By selling down to £28 for forward delivery a temporary effect was produced, but prices quickly rallied, and the cheap offers have already disappeared. Latest price for foreign is £28 10s.

IRON, STEEL, PIG-IRON, &c.

SCOTLAND.

Messrs. David Colville and Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, N.B., quote as follows Prices delivered in Glasgow or equal:—

		£	s.	d.
Steel:				
DALZELL	Siemens' Steel Plates, Marine Boiler Quality ..	8	2	6
STEEL	,, ,, ,, Land ,, ,, ...	8	2	6
	,, Steel Bars, Boiler Quality	8	5	0
DALZELL	Siemens' Steel Plates, Ship Quality Plates......	7	2	6
STEEL	,, ,, Bars ,, ,, ...	7	15	0
	,, ,, Angles	6	15	0

Manufactured Iron:

	£	s.	d.
Bars—Dalzell..	7	2	6
,, Best	7	12	6
,, ,, Horseshoe	7	12	6
,, Angle	7	2	6
,, Best Angle	7	12	6
,, Best Best	8	2	6
,, Extra Best	8	12	6

Usual terms and extras. Special rates for delivery in England and export. The above prices subject to alteration without notice.

The Glasgow Iron and Steel Co., Ltd., Wishaw, quote as under (prices are delivered Glasgow or equal):—

(Glasgow Steel)	£	s.	d.	
Steel Angles	6	10	0	per ton.
Steel Ship Plates	6	17	6	,,
Steel Bars, Ship Quality	7	10	0	,,
Glasgow Steel.				
Steel Bars, Boiler Quality	8	0	0	,,
Steel Land Boiler Plates	7	7	6	,,
Steel Marine Boiler Plates	7	7	6	,,

Less 5 per cent discount Extras as per standard list.

Special prices for delivery in England and for export. The above prices subject to alteration without notice.

John Spencer (Coatbridge), Ltd., Phœnix Ironworks, Coatbridge, N.B., quote:

	£	s.	d.
Bars [illegible]	7	5	0
Best	7	15	0
Best Best	8	5	0
Extra Best	8	15	0
Best Horse Shoe	7	15	0
Extra B.H.S.	8	15	0
Extra Best C[illegible]	9	5	0
Rivet	7	5	0
Best Scrap Rivet	8	5	0

	£	s.	d.
Angles—Phœnix	6	15	0
,, Best	7	5	0
,, Extra Best	7	15	0
Gas Tube Hoops—Phœnix Best	7	5	0
Plates—Phœnix	—		
,, Best Boiler	8	0	0
,, Best Best Boiler	8	10	0
,, Extra Best Boiler	9	10	0
Boiler Tube Strips—Phœnix Best Best	8	10	0

All per ton, delivered f.a.s., Glasgow, Greenock, Grangemouth, Granton, Leith, or Ardrossan. 5 per cent. discount cash monthly.

Messrs. R. Feldtmann and Co., of Glasgow, quote (Commission extra).

Pig Iron:	No. 1.			No. 3.		
	£	s.	d.	£	s.	d.
Coltness, f.a.s. Glasgow	3	5	0	3	5	0
Gartsherrie ,,	3	7	6	3	2	6
Summerlee ,,	3	11	0	3	6	0
Carnbroe ,,	3	5	0	3	2	0
Langloan ,,	3	8	0	3	3	0
Calder ,,	3	7	6	3	2	6
Clyde ,,	3	7	0	3	2	0
Glengarnock, f.o.b. Ardrossan	3	8	0	3	0	0
Eglinton ,, ,,	3	2	6	3	0	0
Dalmellington, ,, Ayr	—			3	0	0
Shotts ,, Leith	3	7	6	3	2	0

NORTH OF ENGLAND.

Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton, quote as follows, **at works**:—

	£	s.	d.
W.W. Bars	7	5	0
W.W. Best Bars	7	12	6
W.W. Best Best	8	5	0
W.W. Best Best Best	8	15	0
W.W. Best Shoe	7	12	6
Thornaby	8	12	6
Thornaby Best	9	2	6
Thornaby Best Best	10	2	6
Whitwell Special Admiralty Cable	10	12	6
Special Chain Iron	9	12	6
Tube and Nail Strips	7	7	6
W.W. Angle Iron	7	7	6
W.W. Best Angle Iron	7	15	0
Tee Iron, to 8-inches United	8	5	0

Terms, Cash, less 2½ per cent. discount on 10th of month following delivery.

LANCASHIRE.

The Pearson and Knowles Coal and Iron Company, Ltd. Dallam and Bewsey Forges, Warrington, announce that in the present uncertain state of the market, their quotations are temporarily withdrawn.

WORCESTERSHIRE.

Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport, quote:—

	Singles 20 G 96in. by 36in. per ton.			Doubles 21 G to 24 G 96in. by 36in. per ton.		
Black Sheets	£	s.	d.	£	s.	d.
"Vale"	10	10	0	11	0	0
"Shield"	11	0	0	12	0	0
"Severn"	12	0	0	13	0	0
"Baldwin Wilden B."	13	0	0	14	0	0
Charcoal	17	0	0	18	0	0
Best Charcoal	19	0	0	20	0	0

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in. Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

Patent Coated Sheets:	£	s.	d.	£	s.	d.
No. 3 Lead	14	0	0	15	0	0
S.V. Lead	15	10	0	16	10	0
No. 3 Terne	15	10	0	16	10	0
S.V. Terne	17	0	0	18	0	0

	Singles 26 G to 108 by 36in. per ton.			Doubles 21 to 24 G to 96 by 36in. per ton.		
Tinned Sheets:	£	s.	d.	£	s.	d
Best Coke (Finish)	29	0	0	30	10	0
,, Charcoal (Finish)	31	0	0	32	10	0
Extra ,,	33	0	0	34	10	0

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for.

Tin Plates, "Cookley, K" Best Charcoal, £1 7s. 0d. per box.

Extreme sizes in Tin and Patent Coated specially quoted for.

Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands.

At works.

Galvanized Corrugated Sheets:

	£	s.	d.	
"Phœnix" Brand, 24 G., f.o.b. London, in Bundles	13	5	0	per ton.
"Blackwall" Brand, 26 G., in felt-lined cases for Australia, f.o.b. London	15	10	0	,,

Galvanized Working Up-Sheets:

	£	s.	d	
24 G., f.o.b. London, in Bundles	14	5	0	per ton.

STAFFORDSHIRE.

Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-Trent, North Staffordshire, and 122, Cannon Street, London, quote:—

	£	s.	d.	
Crown Bars	7	0	0	per ton.
Best Bars (1 to 6in. wide, above ¼ in. thick, ½ in. to 4 rounds and squares)	7	10	0	,,
Angles	7	5	0	,,
,, Best	7	15	0	,,
T's	7	10	0	,,
,, Best	8	0	0	,,
Best Shoe Iron	8	10	0	,,
,, Rivet Iron	8	10	0	,,
,, Best Rivet (Special)	9	15	0	,,
,, Cable	9	15	0	,,
,, Screwing	8	15	0	,,

	£	s.	d.	
Best Turning	8	10	0	per ton.
,, Plating	8	15	0	,,
Best Best	9	15	0	,,
Treble Best	10	15	0	,,
Plates	8	0	0	,,
Best Plates	8	10	0	,,
,, Boiler Plates	9	0	0	,,
,, Best Boiler Plates	10	0	0	,,
Treble Best Boiler Plates	12	10	0	,,

Delivery f.o.b. Liverpool, Birkenhead or Manchester.

WALES.

Cordes (Dos Works), Ltd., of Newport, Mon., quote "Star" brand patent wrought nails steel nails, &c.

Discounts—

45 per cent. off 1-inch to 3-inch strong rose and all fine rose and 6dy. and 8dy. pound.

40 per cent. off 3½ inch to 7-inch strong rose and 10dy. and 20dy. pound.

40 per cent. off all sharp-pointed nails.

Delivered in lots of 4 cwt. and upwards. Extra 2½ per cent. discount off the gross on two tons and upwards.

Steel rose, flat points, 5-inch to 7-inch basis :—

2 tons 10/6 per cwt.
4 cwt. lots and upwards 10/9 per cwt. } d/d any Railway Station.

Steel cut nails, 3-inch basis—

2 tons 9/3 per cwt.
4 cwt. lots 9/6 per cwt. } d/d any Railway Station.

Slit rods (iron) £7 10s. per ton, at works for 2-ton lots.

Messrs. Richard Thomas and Co., Ltd., of 33 and 35, Eastcheap, E.C. — Works: South Wales, Burry, Lydney, Lydbrook, and Cwmbwrla, quote :—

Coke Tin-plates.	Per Box. f.o.b. Wales. £	s.	d.
C 18¾ by 14 124s. 110 lb. "BV"	0	13	3
C 20 by 10 225s. 155 ,, "Jumbo"	0	18	9
C 20 by 14 112s. 108 ,, "Lydbrook"	0	13	0
C 28 by 20 112s. 216 ,, "Lydbrook"	1	6	3

Charcoal Tinplates :

C 20 by 14 112s. 108 lb. "Allaway"	0	13	9

BELGIUM.

C. L. Faulkner, Suffolk House, Laurence Pountney Hill, London, E.C., quotes :—

Prices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) delivered free on board ANTWERP for approved quantities.

Steel:	£	s.	d	
Blooms	at 3	19	0	per ton.
Billets	at 4	1	0	,,
Sheet Bars	at 4	3	0	,,

Finished Steel :

Bars	at 5	7	6	per ton.
Angles	at 5	8	6	,,
Tees	at 5	11	6	,,
Joists	at 4	17	6	,,
Fencing Standards	at 5	10	0	,,
Shoeing Bars	at 5	12	6	,,
Tyre Bars	at 5	12	6	,,
Half-Round Bars	at 5	17	6	,,
Heavy Rails	at 5	10	0	,,
Light Rails	at 5	0	0	,,

Structural Steelwork :

Prices on application.

METALS.

Messrs. French and Smith, 147, Leadenhall Street, and 11, Oldhall Street, Liverpool, quote :—

TIN.

Tin :	£	s.	d		£	s.		
English Ingots, f.o.b. Dis. 1½ % & 1 %	152	0	0	to	152	10	0	per ton
English Bars, f.o.b. Dis. 1½ % & 1 %	153	0	0	to	153	10	0	,,
Straits G.M.B., cash Warehouse, Net	149	17	6	to	150	0	0	,,
Straits G.M.B., 3 months, Warehouse, Net	149	2	6	to	149	5	0	,,
Australian, Mt. Bischoff, Warehouse, Net	150	10	0	to	150	15	0	,,

COPPER.

Copper :	£	s	d.		£	s.	d.	
Standard G.M.B., cash Warehouse, Net	71	5	0	to	71	7	6	per ton.
Standard G.M.B., 3 months, Warehouse, Net	70	10	0	to	70	12	6	,,
English, Tough, Cake & Ingot, Warehouses, Net	76	10	0	to	77	0	0	,,
English, Best Select, Warehouse Net	77	0	0	to	77	10	0	,,
English, Sheets and Sheathing, f.o.b., Dis. 2½ %	85	0	0	to	86	0	0	,,
English, Sheets for India, f.o.b., Dis. 2½ %	80	0	0	to	80	10	0	,,
Electro, Warehouse, Net	76	5	0	to	76	10	0	,,
Ore, ex ship	0	13	3	to	0	14	3	per unit
Regulus, Matte and Precipitate, ex ship,	0	14	3	to	0	14	9	,,

YELLOW METAL.

Yellow Metal :	£	s.	d.	
Sheets, 4 by 4 feet for India f.o.b. Dis. 2½	0	0	6¾	per lb
Sheathing ,, ,,	0	0	7	,,

SPELTER.

	£	s.	d.		£	s.	d	
Silesian outports, Net	28	7	6	to	28	10	0	per ton.
Blende of 50 % Net	8	0	0	to	8	1	6	,,
Calamine, Net	8	2	6	to	8	4	0	,,

LEAD

	£	s.	d.		£	s.	d	
English Pig, Warehouse, Dis. 2½	15	5	0	to	15	7	6	per ton.
Spanish, ex ship, Dis. 2½	15	0	0	to	15	2	6	,,
Lead Ore of 70 %, Net	7	9	0	to	7	10	0	,,

ANTIMONY.

	£	s.	d.		£	s.	d.	
Star Regulus, f.o.b., Dis. 2½	50	0	0	to	52	0	0	per ton.
Ore [illegible] ex ship, Dis. 2½	15	0	0	to	15	10	0	,,
Crude ex ship, Dis. 2½ %	28	0	0	to	30	0	0	,,

QUICKSILVER.

	£	s.	d	
Spanish [illegible] Warehouse, Net	7	5	0	per flask
Italian	7	2	6	,,

COAL.

LEICESTERSHIRE.

The Nailstone Colliery Company, Leicester, quote. Price per Ton at Pit of 20 Cwt., with $\frac{1}{2}$ Cwt. per Ton for wastage —

Upper Main Seam.

	s.	d.
Main Coal	6	6
Best Hard Steam (hand picked, as used by the Railway Companies)	5	6
Best Hard Steam Cobbles (made through 6 in. mesh, free from slack)	6	0
Fine Slack	0	6

Terms, net cash on 10th of month following delivery.

DERBYSHIRE.

The Manners Colliery Co., Ltd., of Ilkeston quote as follows, per ton at pit:

Kilburn Coal:

	s.	d.
Best London Brights	9	3
Large Nuts ($1\frac{1}{2}$ to $3\frac{1}{2}$)	9	0
Small Nuts ($\frac{3}{4}$ to $1\frac{1}{2}$)	6	0
Peas ($\frac{3}{8}$ to $\frac{3}{4}$)	5	0
Rough Slack	4	0
Slack	3	6
Smudge	2	0

Rutland Coal:

Brights (4 to 8)	7	6
Large Nuts (2 to 4)	7	0
Slack	3	6
Hand-picked Hards	7	6
Hard Cobbles	6	3

The Clay Cross Company's Collieries, Clay Cross, near Chesterfield, quote:—

	per ton at pit. s.	d.
Best Main Coal	10	6
Best Silkstone	10	0
Best House Coal	8	6
Best House Nuts	8	0
Treble Screened Cobbles	7	9
Best Cobbles	7	3

NOTTINGHAMSHIRE.

The Digby Colliery Co., Ltd., near Nottingham, quote per ton at pit:—

Digby Coal:

STEAM.

	s.	d
Best Hand Picked Hard	8	6
Steam Hard	7	3
Hard Nuts	6	6

Gedling Colliery.

HIGH HAZEL (or Ashless House Coal).

London Brights, 4 to 8 in. cube	10	6
Bright Cobbles (Hand Picked)	10	0
Large Nuts, 2 to 4 in. cube	9	6
Small Nuts, 1 to 2 in. cube	6	0
Pea Nuts, $\frac{3}{8}$ to 1 in. cube	5	6

STEAM—TOP HARD.

Best Hard	8	6
Hard Steam	7	6
Cobble	6	3

CHEMICALS.

Messrs. S. W. Royse and Co., Albert Square, Manchester, quote:

	£	s.	d.	
Acids: Oxalic	0	0	$2\frac{1}{4}$	per lb.
Picric, Crystals	0	0	11	,,
Tartaric ... at Manchester	0	0	$10\frac{3}{4}$	,,

	£	s.	d.	
Acetate of Lime: Brown at Manchester net	8	10	0	per ton.
Grey ,,	11	15	0	,,
Alumina: Alum, Lump, loose	5	5	0	,,
,, ,, in casks	5	7	6	,,
,, Ground, in bags	5	15	0	,,
Sulphate of Alumina, 14%	4	10	0	,,
Ammonia: Carbonate	0	0	$3\frac{5}{8}$	per lb.
Muriate Grey f.o.b. Liverpool	24	15	0	per ton.
Sal-ammoniac, Lump, 1sts, deld. U.K.	42	0	0	,,
,, ,, 2nds, ,,	40	0	0	,,
Sulphate ... f.o.b. Liverpool	13	0	0	,,
Arsenic: Best White Powdered ... net	14	17	6	,,
Bleaching Powder, 35% ... ,,	4	7	6	,,
Borax: British Refined Crystal ... ,,	13	0	0	,,

Coal Tar Products:

	£	s.	d.	
Benzole, 50/90% ... ,,	0	0	$8\frac{1}{2}$	per gal.
,, 90% ... ,,	0	0	9	,,
Carbolic Acid Crystals, 34/35° C. ... ,,	0	0	$5\frac{1}{4}$	per lb.
,, ,, ,, 39/40° C. ... ,,	0	0	$5\frac{3}{4}$	,,
,, ,, Liquid, 97/99% ... ,,	0	0	9	per gal.
,, ,, Crude, $62\frac{1}{2}$% at 60° F. f.o.b. ,,	0	1	8	,,
Creosote, ordinary good liquid ... ,,	0	0	$1\frac{7}{16}$	,,
Naphtha, Crude, 20% at 120° C. ... ,,	0	0	$3\frac{1}{4}$	,,
,, Solvent, 90% at 160° C. f.o.b. ,,	0	0	$10\frac{1}{2}$	,,
,, ,, 95% at 160° C. ,, ,,	0	0	$11\frac{1}{2}$	,,
,, ,, 90% at 190° C. ,, ,,	0	1	0	,,
,, Rectified, flash point over 73° F. ... f.o.b. ,,	0	1	0	,,
,, Rectified, flash point over 100° F. ... f.o.b. ,,	0	1	1	,,
Naphthalene, all qualities.				
Pitch ... f.a.s. Manchester. ,,	1	13	0	per ton.
Copperas: Green, in bulk ... ,,	0	12	6	,,
,, barrels f.o.b. L'pool ,,	1	18	6	,,
Cake ... ,,	1	1	6	,,
Copper: Sulphate	22	15	0	,,
Cyanides: 98% minimum ... f.o.b. net	0	0	$7\frac{1}{2}$	per lb.
Lead: Acetate (Sugar) White, English	27	10	0	per ton.
,, ,, ,, Foreign c.i.f. U.K.	24	0	0	,,
,, ,, Grey	22	15	0	,,
,, ,, Brown at Manchester	17	5	0	,,
Nitrate	25	10	0	,,
Litharge, Flake	17	0	0	,,
,, Powder	17	10	0	,,
Red Lead, Genuine, c.i.f. London less 5%	16	10	0	,,
White ,, ,, Dry ,, ,, ,,	17	10	0	,,
Naphtha (Wood): Miscible, 60 o.p.	0	2	4	per gal.
Solvent	0	2	7	,,
Potash: Bichromate... delivered England ...	0	0	8	per lb
Carbonate, 90/92% ... c.i.f Hull ...	17	15	0	per ton.
Caustic, 75/80% ... ,, ,, ...	19	5	0	,,
Chlorate ... net	0	0	$3\frac{1}{4}$	per lb.
Montreal ... in Store, Liverpool	31	10	0	per ton.
Prussiate Yellow ... net	0	0	$4\frac{1}{2}$	per lb.

		£	s.	d.	
Soda: Ash, Caustic, 48 %, Ordinary	net	5	5	0	per ton.
,, ,, ,, Refined	,,	6	5	0	,,
,, Carbonated, 48 %	,,	5	10	0	,,
,, ,, 58 % (Ammonia Alkali)	net	4	10	0	,,
,, Bleachers' Refined Caustic 50/52 %	net	6	10	0	,,
Caustic, White, 77 %	,,	10	12	6	,,
,, ,, 70 %	,,	9	12	6	,,
,, ,, 60 %	,,	8	12	6	,,
,, Cream, 60 %	,,	8	10	0	,,
Crystals, in bags		3	0	0	,,
,, barrels		3	7	6	,,
Acetate	c.i.f. Hull net	16	10	0	,,
Bicarbonate, in 1 cwt. kegs		6	15	0	,,
Bichromate......delivered England		0	0	2¼	per lb.
Chlorate	net	0	0	3½	per lb.
Nitrate...ex quay Liverpool,	,,	11	0	0	per ton.
Phosphate		9	5	0	,,
Prussiate	net	0	0	$3\frac{7}{16}$	per lb.
Silicate, Solution, 140° Tw.		4	10	0	per ton.
Sulphate (Glauber Salts)		1	10	0	,,
,, (Saltcake, 95%)		1	15	0	,,
Sulphur: Recovered		4	15	0	,,
Roll		6	15	0	,,
Flowers		7	10	0	,,
Zinc: Sulphate		6	15	0	,,
Shellac: Standard TN orange spot		9	0	0	per cwt.

MINERALS.

Messrs. S. W. Royse and Co., quote:—

	£	s.	d.	
Barytes: Lump Carbonate, 90/92%	3	10	0	per ton.
Sulphate, No. 1, White	2	15	0	,,

China Clay: of various qualities for all purposes; prices from about 11/- to about 30/- per ton, f.o.b. Cornwall: stocks also kept at Runcorn and Preston. Quotations given carriage paid.

	£	s.	d.	
Chrome Ore: Basis 50% c.i.f. British Ports	3	10	0	,,
Manganese: Lump c.i.f. Liverpool 10½d. per metallic unit.				
Ochre: French JC .... f.o.b. Rouen, net	2	5	0	per ton.
,, JF	5	10	0	,,
Talc: (French Chalk).........c.i.f. Liverpool	3	10	0	,,

Messrs. Henry Bath and Son, quote:—

	£	s.	d.		£	s.	d.	
Copper, Ores of, 10 to 25%	0	13	4½	to	0	14	4½	per unit.
Regulus, 45 to 55%	0	14	4½	to	0	14	10½	,,
Precipitate, 65 to 80%	0	14	6	to	0	15	0	,,
Tin Ores, 70 %	93	0	0	to	95	0	0	per ton
Lead Ore, 70%					7	19	0	,,
Blende, 50%					8	6	6	,,
Calamine					8	9	0	,,
Antimony, Star Regulus	50	0	0	to	52	0	0	,,
,, Ore 50%	15	0	0					

Messrs. Barrington and Holt, Cartagena, quote:—

Iron Ore.

			s.	d.	
Ord. 50%,	f.o.b.	Porman	7	6	per ton.
Do.	,,	Cartagena	7	10	,,
Special low phos.	,,	Porman			
Do. do.	,,	Cartagena	[illegible]	[illegible]	,,
Extra quality do.	,,	,,	8	6	,,
Special Iron Ore	,,	,,	nominal		,,
Specular 58% do.	,,		11	0	,,
S P. Campanil Coast	,,		[illegible]	[illegible]	,,

TIMBER.

Messrs. Alfred Dobell and Co., Liverpool, quote:—

COLONIAL WOODS.

Timber.

		£	s.	d.		£	s.	d.
Quebec Square White Pine	per cub. ft.	0	1	9	to	0	3	3
Quebec Waney Board Pine	,,	0	2	8		0	3	9
St. John Pine, 18 in. average	,,	0	2	4		0	3	3
Lower Port Pine	,,	0	1	3		0	1	8
Quebec Red Pine	,,	0	1	6		0	2	3
Quebec Oak, 1st quality	,,	0	2	9		0	3	4
Quebec Oak, 2nd quality	,,	0	1	6		0	2	6
Ash	,,	0	1	6		0	2	3
Elm	,,	0	3	3		0	4	0
Hickory	,,	0	2	0		0	2	6
Quebec Birch	,,	0	1	6		0	2	3
St. John Birch	,,	0	1	6		0	2	0
Birch Planks	,,	0	0	9		0	0	11
Spruce Spars	,,	0	0	10		0	1	0

Deals.

		£	s.	d.		£	s.	d.
1st quality Quebec Pine	per std.	22	10	0	to	32	10	0
2nd do. do.	,,	17	0	0		22	0	0
3rd do. do.	,,	11	10	0		13	0	0
St. John, Miramichi, etc., Spruce	,,	7	10	0		7	15	0
Nova Scotia Spruce	,,	7	7	6		7	12	6
Spruce Boards	,,	6	7	6		6	12	6

UNITED STATES, etc., WOODS.

Pitch Pine.

		£	s.	d.		£	s.	d.
Hewn	per cub. ft.	0	1	4	to	0	1	8
Sawn	,,	0	1	0		0	1	6
Planks, Stowage	,,	0	0	10		0	1	0
Boards, Prime	per std.	12	10	0		16	0	0
Oak Timber	per cub. ft.	0	1	6		0	2	6
Oak Planks	,,	0	1	6		0	2	1
East India Teak	per load	12	0	0		19	0	0
Greenheart	,,	6	15	0		7	10	0

EUROPEAN WOODS.

Timber.

		£	s.	d.		£	s.	d.
Riga Redwood	per cub. ft.	0	1	6	to	0	2	0
Dantzic and Memel Fir, Crown	,,	0	2	1		0	2	6
Dantzic and Memel Fir, Middling	,,	0	1	9		0	1	11
Stettin	,,	0	1	9		0	1	11
Swedish	,,	0	1	0		0	1	3
Riga Whitewood	,,	0	1	0		0	1	3
Norway Mining Timber	,,	0	0	9		0	1	0
Dantzic and Stettin, etc., Oak	,,	0	2	6		0	3	0
Norway Spars	,,	0	1	2		0	1	9

Deals.

		£	s.	d.		£	s.	d.
[illegible] Archangel and Onega 1st quality	per std.	19	0	0		20	0	0
Red Archangel and Onega, 2nd quality	,,	14	0	0		16	0	0
[illegible] Archangel and Onega 3rd quality	,,	10	10	0		12	10	0
[illegible], 1st quality	,,	16	0	0		17	10	0
Do. 2nd do.	,,	14	0	0		15	0	0
[illegible]	,,	11	10	0		16	0	0
[illegible]		11	0	0		12	10	0
[illegible]	,,	10	0	0		12	10	0
[illegible]		11	0	0		16	0	0

SELECTED PATENTS.

Compiled expressly for this journal by **Messrs. Page and Rowlingson, Engineering Patent Agents, 28, New Bridge Street, London, E.C.,** and at Manchester.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton Buildings, Chancery Lane, W.C., at the uniform price of 8d

NEW PATENTS APPLIED FOR.

When patents have been communicated the names of the communicators are printed in *italics*.

19564. N. W. Rasnick, London. Sept. 26th.—Improvements in forges.

19594. J. Blake, Stockton - on - Tees. Sept 28th.—Improvements in connection with steam boilers.

19615. L. Silvermann and J. D. Siddeley, London. Sept. 28th.—Improvements in and relating to change speed gear.

19632. C. Semmler, London. Sept. 28th.—Turbines operated by steam and hot gases. (Date applied for Sept. 28th, 1904.)

19641. H. Fottinger, London. Sept. 28th.—Progress of and means for automatically determining the rotary moments of rotating shafts from their torsion in running. (Date applied for Nov. 7th, 1904.)

19642. J. H. Foust, London. Sept. 28th.—Improvements in boring implements. (Date applied for Nov. 5th, 1904.)

19645. P. Jensen, London. Sept. 28th.—Improvements in and relating to lubricators.

19647. R. B. North, London. Sept. 28th.—Improvements in apparatus for indicating gradients.

19664. H. Ried, and D. M. Ramsey, Glasgow. Sept. 29th.—Improvements in locomotives.

19695. C. C. Wakefield, and R. Janson, London. Sept. 29th.—Improvements in or relating to internal combustion engines.

19697. C. H. E. Rush, London. Sept. 29th.—Improvements relating to internal combustion engines.

19707. C. M. Spencer, London. Sept 29th.—Improvements in automatic multiple spindle screw machines.

19708. H. J. Hudson, and R. J. Halls, London. Sept. 29th.—Improvements relating to variable speed gearing.

19711. H. John, London. Sept. 29th.—Improvements in and relating to ratchet feeding mechanism.

19717. N. J. Suckling, London. Sept. 29th.—Improvements relating to water-tube steam generators.

19747. W. Hillman, London. Sept 29th.—Improvements in carburetters.

19770. A. H. Walker, Cheshire. Sept. 30th.—Automatic steam brake.

19774. G. H. Hislop, London. Sept. 30th. Improvements in steam boilers and like furnaces.

19818. F. A. Ford and K. L. Karch, London. Sept. 30th.—Improvements in and connected with machines for drilling square and other angular [illegible]

20901. W. A. Ashworth, Manchester. Oct. 26th.—Improvements in lubricating apparatus.

20937. A. J. Irvine D. Mills, and W. H. Wood, London. Oct. 26th.—Improvements in means for separating water from steam in boilers.

20941. A. E. W. Constans, London. Oct. 26th.—Improvements in machines for lixiviation processes.

20955. J. F. W. Polack, London. Oct. 26th.—Improvements in container pumps.

20958. L. Illmer, Junior, and E. J. Kunze, London. Oct 26th.—Improvements in internal combustion engines.

20963. L. Illmer, junior, and E. J. Kunze, London. Oct. 20th.—Improvements in gas-engine plants.

20966. R. C. Bishop, London. Oct. 26th.—Improvements in and relating to gas-heated boilers.

21020. J. O. Heinze, Junior, London. Oct. 17th.—improvements relating to rotary current interrupters.

21021. C. Becker, Yorkshire. Oct. 17th.—Improvements in certain fluid pressure engines.

21044. P. G. Barden, and H. E. Spall, London. Oct. 17th.—Improvements in variable speed gears.

21100. S. Glover, and R. B. Glover, Lancashire. Oct. 18th.—Improvements in gas engines.

21105. J. Dewar, Glasgow. Oct. 18th.—Improvements in and relating to variable speed gearing.

21123. C. A. Pooley, Bristol. Oct. 18th—Improvements in valve gear for explosion engines.

21126. H. A. Neal, and A. P. Smith, London. Oct. 18th.—Improvements in or relating to steam generators.

21138. E. H. Owen, London. Oct. 18th.—An improvement relating to internal combustion motors.

21143. F. Edwards, London. Oct. 18th.—Improvements in explosion engines.

21161. D. Spartaco, London. Internal combustion engine with retarded compression. (Date applied for March 15th, 1905.)

21190. A. Separator, and E. A. Forsberg, London. Oct 18th.—Improvements in and relating to centrifugal separator for liquid.

21213. F. C. Lynde, Manchester. Oct 19th—Improvements in carburetters.

21215. R. W. Smith, Birmingham. Oct. 19th.—An improved three speed gear hub for cycles.

21216. R. W. Smith, Bimingham. Oct. 19th. A combination speed gear hub and back-pedalling brake.

21248. J. A. E. Pellorce, London. Oct 19th. —An electric machine for use in automobile and for other purposes.

21253. J. Becker, London.—Oct. 19th.—Improvements relating to hydraulic machine tools operated by steam.

21256. E. Towlson, and H. R. Moulton, London. Oct. 19th.—An improved rotary pump and blower.

21257. H. W. Walker, London. Oct. 19th. —An improved change speed gear for motor cars and the like.

21263. H. Lentz, London. Oct. 19th.—Improvements relating to steam and gas turbines.

21281. H. Hall, London. Oct. 19th.—Improvements in the transmission of expansive fluid energy to turbines and water motors.

21285. G. E. J. Alphandéry, London. Oct. 19th.—An improved device for facilitating the removal of valves from the valve boxes of internal combustion engines.

21297. W. H. Eley, A. R. Barnes, London. Oct. 19th.—A new or improved variable speed gearing.

21324. F. Turnbull, Middlesborough. Oct. 20th.—Improvements in rotary tipplers.

21325. J. McNeil, Glasgow. Oct. 20th.—Improvements in valves.

21363. F. W. Gunton, London. Oct 20th. —Improvements relating to automatic regulating devices for use with internal combustion engines.

21395. J. Woodhead, and H. Wood, Manchester. Oct. 21st—A new or improved silencer for internal explosion engines.

21404. A. E. Adlard, Sussex. Oct. 21st.—A continuous self-impelling engine.

21414. J. M. Ross, London. Oct 21st—Improvements in variable speed gear.

21149. A. W. Southey, London. Oct. 21st—Improvements in or connected with internal combustion engines.

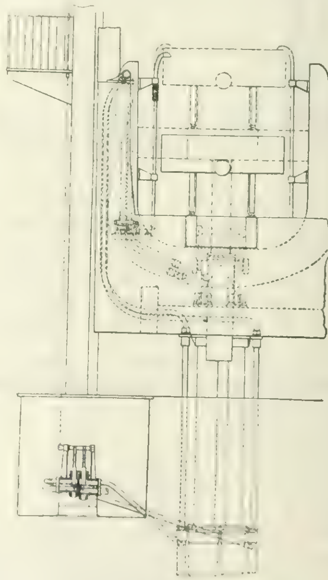
RECENT SPECIFICATIONS.

"IMPROVEMENTS IN APPLIANCES FOR SHIPPING OR TRANSFERRING COAL AND THE LIKE."

Sir W. G. Armstrong, Whitworth and Co., Ltd., and R. Wright. September 28th, 1905. This invention relates to apparatus by which coal wagons or the like are tipped, the wagons being run on to rail carried by a cradle, in which they are clamped and held while the cradle is tipped.

The object of this invention is to provide means for dealing with wagons having sides of varying height. The rails upon the wagon rests are carried by a movable platform inside the cradle. The platform can be moved up and down by hydraulic cylinders or other motive power, through a range corresponding with the difference in height between the highest and lowest wagons to be dealt with. Toggle levers and bars may be used to ensure the platform rising and falling parallel to the cradle. The water for actuating the cylinders is conveyed from the working valve through a sliding or telescopic pipe to a joint centred on the hinge of the tipping cradle and from thence to the cylinders. Clamps secure the wagon when raised by the cylinders, and an automatic cut-off valve and gear is arranged to come into action when the wagon is raised to its highest position, and thus damage to the wagon is avoided. In the arrangement as described above, the top edge of the wagon, whether it be a high or low one is, when turned over by the tipping machinery, always in the same position relative to the hopper or shoot, and thus the coal is delivered to the hopper without any spilling whatever the size of the wagon, and with a minimum of breakage.

The drawing is an end view of such an apparatus, and shows the cradle carried by the hoist and tipping about a hinge, and a movable platform inside the cradle supporting the rails on to which the truck is run. This platform can be raised by the ram of a hydraulic cylinder, to which water is admitted by a



working valve, a pipe, and a telescopic pipe connected at the hinge to a pipe leading to a cut-off valve and pipe. When the hoist has been raised into the position shown, water is admitted to the cylinder to raise the platform until the truck has been raised sufficiently to bring its sides up to the clamps. As the truck nears the top of the lift it engages a hook on a spring rod which shuts the cut-off valve. After the truck has been discharged it is returned to the horizontal position by the tipping machinery, and in order to lower the truck and the platform to their normal position on the cradle the cylinder is open to the exhaust. This is done by means of a pipe connected to the pipe shown dotted, the telescopic pipe, and the exhaust spindle of the working valve. When the platform has fallen a spring acting on the rod opens the cut-off valve ready for the next operation.

NEW PUBLICATIONS.

"THE MECHANICAL EQUIPMENT OF COLLIERIES."

By the late C. M. Percy, F.G.S., M.I.M.E., M.I.Mech.E. Completed and edited by Frank Percy, M.I.M.E., A.M.I.Mech.E., and George H. Winstanley, F.G.S., M.I.M.E. Manchester: James Collins and Kingston, Ltd.

A melancholy interest attaches to this volume, which, in many respects, is a monumental one. The work was very near completion when the death was announced of the experienced engineer responsible for its compilation. The late principal of the Wigan Mining College was a man of unusual aptitudes, and it would be difficult to find anyone better qualified for the authorship of a book of this nature. It is not too much to say that no one more fully appreciated or comprehended the conditions and requirements of the mining student than he, whose life for over thirty years was inseparably associated with the Wigan centre of mining education. As far as practicable, his original manuscript has been rigidly adhered to, and, in instances where revision was deemed necessary, the editors inform us that they have endeavoured to express the views and principles which they knew to be those of the author. The introductory chapter is mainly of a reminiscent nature, the writer making instructive comparisons between present-day methods and the difficulties encountered about half a century ago. Appropriately enough, the first question to receive attention is that of motive power; discussing the various traits of steam, compressed air, and electricity, the writer maintains that, so far as coal-cutting machines are concerned, although in some instances they are worked by compressed air, their general adoption is only possible by the aid of electricity. Steam, he remarks, is impossible for such a purpose, compressed air pipe ranges could not be otherwise than clumsy and ineffective. Progress in boiler engineering is dealt with at some length, and is followed by an ample discussion of air-compressing machinery, in which all modern developments are illustrated and described. The editors are fully alive to the prominent part which electricity is destined to play in the mechanical equipment of collieries. Mr. Winstanley, of the Victoria University, Manchester, is specially responsible for the electrical portion of the work, and also for the sections dealing with haulage and pumping.

The comprehensiveness of the volume may be estimated from the following brief synopsis of the subsequent chapters: Ventilation—quantity of air and ventilating pressure, recording and indicating instruments; Ropes in colliery use—materials and manufacture, weight and strength, cappings for winding ropes; Pit-shaft guides—rigid guides of wood and iron, cage chains and attachments; Headgears and pit banks—catches or keps, decking gear, detaching hooks, pit-bank weighing machines; Winding engines—calculations relating to force developed by colliery winding engines, details of construction, safety appliances, endless chain winding; Dealing with coal at bank—screening appliances, fixed screens and mechanical screens, picking belts, creepers, tipplers, examples of plant installed; Washing and coking—in this chapter all the leading types of washers are described, and some valuable information con- [illegible] is imparted.

The illustrations are a strong feature; the greater number of the excellent large folding drawings are the work of Mr. Frank Percy, who also augmented the chapters on haulage and screening. The literary matter is remarkably lucid, and, by eschewing involved technicalities and abstruse mathematical formulæ, the editors have been enabled to present a complex subject in such a manner as will be readily assimilated by the student, and at the same time prove of no mean value to the trained engineer.

NEW CATALOGUES.

The Scotch and Irish Oxygen Company, Ltd., Polmadie, Glasgow.—A well printed and illustrated catalogue has been issued dealing with the firm's standard types of valves for gas bottles and refrigerating plant. These, it is to be noted, can be modified in any way possible to suit the requirements of individual users. From the preliminary introduction it will be observed that these valves are made from drop steel or bronze forgings (not castings, as very often employed), and are guaranteed to have been efficiently tested under gas pressure before dispatch from the works. The sectional illustrations show fully the construction of the valves, so that in most cases no further description is necessary. The illustrations have been divided into six sections, namely: (1) Valves for oxygen, hydrogen, and coal-gas bottles; (2) Valves for carbonic acid bottles; (3) Valves for nitrous oxide bottles; (4) Valves for sulphurous acid bottles; (5) Valves for ammonia bottles; (6) Valves for refrigerating plant. Each type is allocated to the section for which it has been generally employed in the past, but, of course, the use of the valves is not limited to their respective sections. The firm call attention to the fact that they have a large department, equipped with modern tools, which is devoted particularly to the manufacture of all kinds of steel and bronze valves and fittings.

The Electrical Company, Ltd. (Lamp Department.) The firm's October price list of Nernst lamps, No. 188, includes all the types, as shown in their old list, and explains fully the special advantages of the lamp, comparing the current consumption of same with that of ordinary incandescent lamps. Attention is called to their "Multiple" lamps, in which the light can be regulated as required, from 180 to 820 candle-power. It is claimed that this type effectively replaces arc lamps, where an even distribution of light is required. There is no re-carboning or flickering of light, but a steady white light is obtained. Some very useful accessories are illustrated on page 24, the small ammeter shown being suggested by the firm as an excellent means of proving the advantages of Nernst lamps over incandescent lamps. Various types of watertight fittings for shop and street lighting are also illustrated. On the last page attention is called to the firm's E.C. (A.E.G.) incandescent lamps. It is incidentally mentioned that the factory has an output of over 15,000,000 lamps per annum. Booklet No. 181, which also reaches us, is entitled "Some Light Talk." It also deals effectively with Nernst lamps, and has been brought out for distribution to small contractors and private consumers. From the tramway material department of the above firm we have received illustrated circulars describing commut[illegible] a type of gear wheel with renewable rims for tramway motors.

PAGE'S WEEKLY Miscellaneous

PAGE'S WEEKLY — Oil Engines

THE MIRRLEES WATSON Co. Ltd.

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LONDON OFFICE. 158 GRESHAM HOUSE OLD BROAD STREET E.C.

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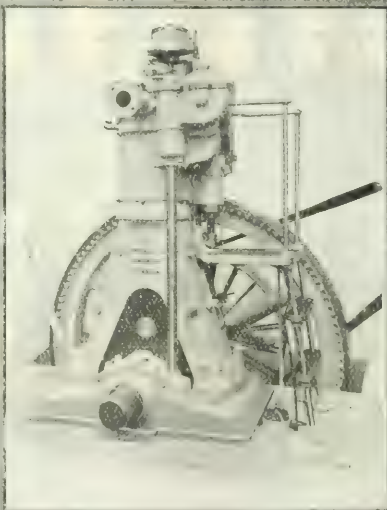

IT IS THE MOST ECONOMICAL ENGINE MADE AND IS MORE RELIABLE THAN ANY OTHER OIL ENGINE.

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Telephone No.: 394.
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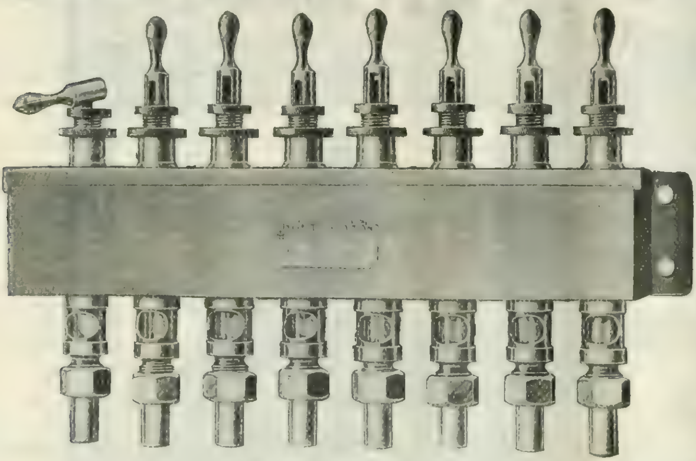

Cast Brass Oil Box, No. 1055.

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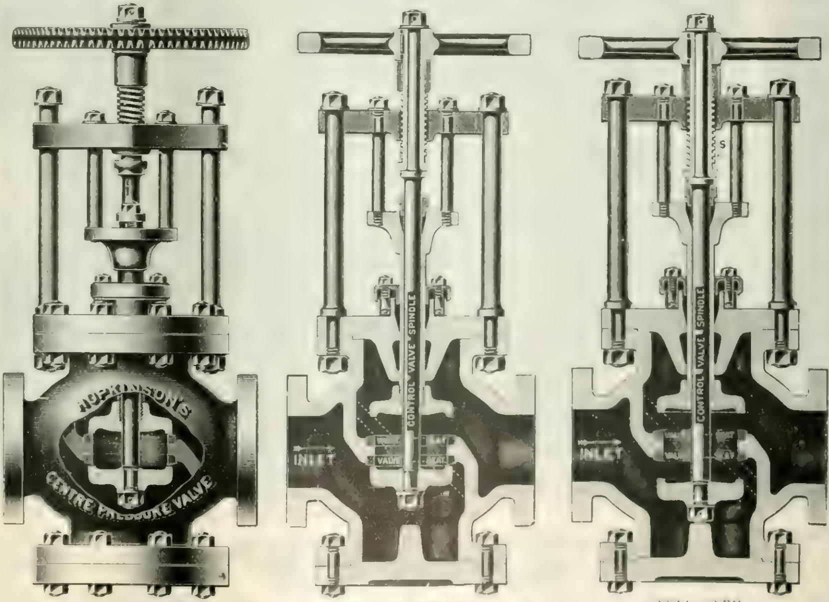
OIL BOXES and LUBRICATORS, STEAM FITTINGS, ENGINE and BOILER MOUNTINGS, HYDRAULIC FITTINGS, PRESSURE GAUGES, &c.

PAGE'S WEEKLY Valves & Boiler Mountings

FOR

VALVES

AND SAFETY BOILER MOUNTINGS.



CLOSED POSITION, showing both valves gripping seats

OPENING POSITION

FULL OPEN

HOPKINSON'S PATENT CENTRE PRESSURE VALVE.

WRITE FOR CATALOGUE

J. HOPKINSON & Co., Limited, HUDDERSFIELD.

PAGE'S WEEKLY — Bessemer Plant

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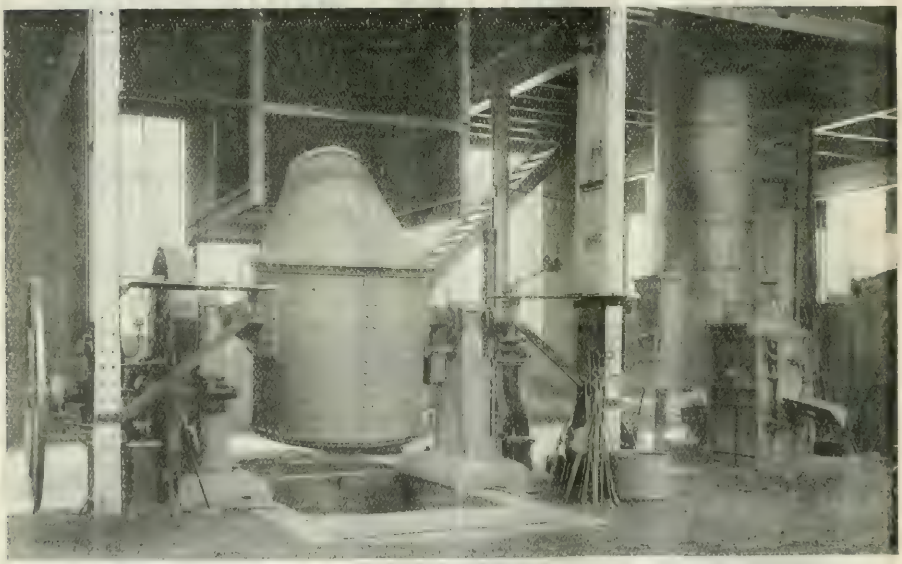

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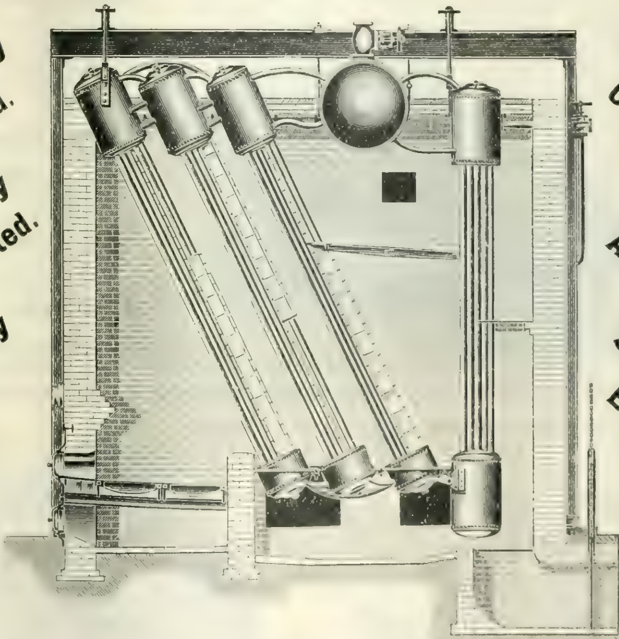

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PAGE'S WEEKLY Electrical Apparatus

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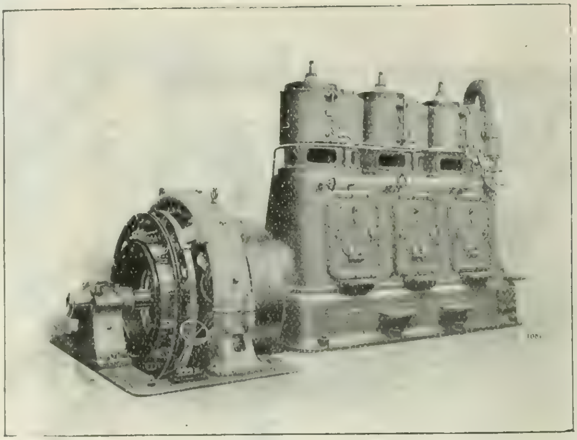

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Main and Tail, or
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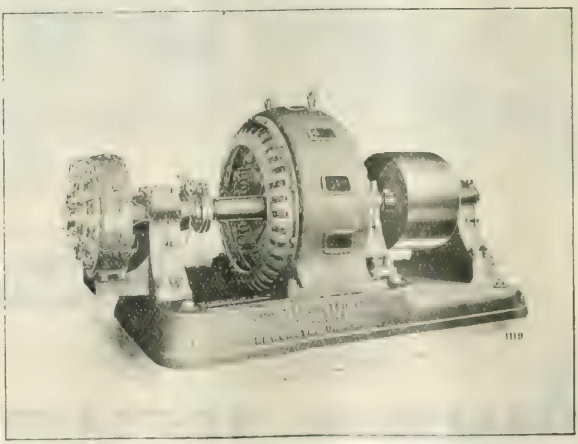

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PAGE'S WEEKLY Electrical Apparatus

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PAGE'S WEEKLY Office Appliances

PAGE'S WEEKLY — Miscellaneous

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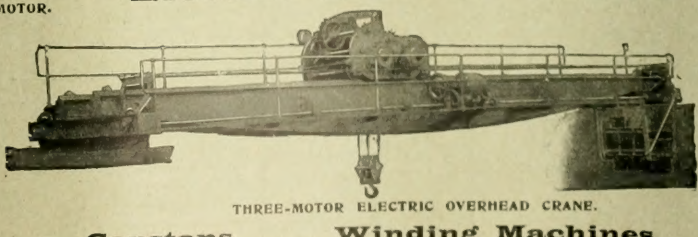

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